MECHANISMS in Modern Engineering Design

A Handbook for Engineers, Designers and Inventors

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Volume IV

Cam and Friction Mechanisms
Flexible-Link Mechanisms

Translated from the Russian by Nicholas Weinstein

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PREFACE

The present, fourth, volume of *Mechanisms in Modern Engineering Design* deals with cam, friction and flexible-link mechanisms. More detailed descriptions are given for many of the more interesting mechanisms, together with some data on the kinematic and length relations of their links. The schematic representations of the mechanisms and the descriptions are given in the same form as in the first three volumes, dealing with lever and gear mechanisms. These mechanisms have also been systemized on the basis of their structural features, with a second classification—based on their service function—given parallel to the first classification.

Two tables, similar to those given in Volumes I and III, enable one to readily find the required mechanisms, either by its structural features or its service function. The mechanisms are additionally listed in alphabetical order in the subject index at the back of the book.

The indices of the subgroups are the same as in the first three volumes, but they have been supplemented by new subgroups given for the first time in this volume.

The reader can find all the information he may need on how this handbook can be most efficiently used, on the conventions applied in the schematical representations and the descriptions, as well as on other matters of this nature, in the preface and introduction published in the first volume.

Grateful acknowledgement is made of the assistance of the

staff of the Department of the Theory of Mechanisms and Machines of the USSR Polytechnical Correspondence Institute and the head of this department, Prof. N. I. Levitsky, D. Sc. (Eng.), who carefully reviewed the manuscript and made many valuable suggestions. Especial thanks are due to the Science Editors, Prof. V. A. Zinovyev, D. Sc. (Eng.) and N. V. Speransky, Cand. Sc. (Eng.) for their participation and assistance in preparing this volume for publication.

Please send all comments on the shortcomings of this handbook, reports on errors found by readers, and suggestions for future changes and supplementary data to Academician I. I. Artobolevsky, Institute of Mechanical Engineering, Ul. Griboyedova, 4, Moscow 101830, USSR. They will be appreciated.

The English translation of the fifth, and final, volume is to be published in 1978.

I. I. Artobolevsky

Table 1

CLASSIFICATION OF MECHANISMS BASED ON STRUCTURAL FEATURES

Group No.	XX			
Group name	Simple Cam Mechanisms			
Group index	SmC			
	No.	Name	Sub-group index	Mechanism No.
	1.	General-purpose three-link mechanisms	3L	2978 through 3061
	2.	General-purpose four-link mechanisms	4L	3062 through 3069
	3.	General-purpose multiple-link mechanisms	ML	3070 through 3099
	4.	Switching, engaging and disengaging mechanisms	SE	3100 through 3104
	5.	Operating claw mechanisms of motion picture cameras	OC	3105 through 3112
	6.	Mechanisms of vibrating machines and devices	VM	3113 and 3114
	7.	Mechanisms for generating curves	Ge	3115
	8.	Mechanisms for mathematical operations	MO	3116 through 3120
	9.	Clutch and coupling mechanisms	C	3121 through 3125
	10.	Brake mechanisms	Br	3126 through 3130
	11.	Link-length adjustment mechanisms	LL	3131 through 3144
	12.	Hammer, press and die mechanisms	HP	3145, 3146 and 3147

Table I (continued)

Group No.	XX			
Group name	Simple Cam Mechanisms			
Group index	SmC			
	No.	Name	Sub-group index	Mechanism No.
	13.	Governor mechanisms	G	3148
	14.	Gripping, clamping and expanding mechanisms	GC	3149 through 3152
	15.	Indexing mechanisms	I	3153
	16.	Piston machine mechanisms	PM	3154
	17.	Sorting and feeding mechanisms	SF	3155
	18.	Mechanisms of other functional devices	FD	3156 through 3171
Group No.	XXI			
Group name	Cam-Lever Mechanisms			
Group index	CmL			
	No.	Name	Sub-group index	Mechanism No.
	1.	General-purpose multiple-link mechanisms	ML	3172 through 3190
	2.	Dwell mechanisms	D	3191 through 3195
	3.	Mechanisms for generating curves	Ge	3196, 3197 and 3198
	4.	Mechanisms for mathematical operations	MO	3199 through 3205
	5.	Operating claw mechanisms of motion picture cameras	OC	3206 through 3217
	6.	Hammer, press and die mechanisms	HP	3218 through 3223
	7.	Gripping, clamping and expanding mechanisms	GC	3224 through 3229
	8.	Link-length adjustment mechanisms	LL	3230 through 3238
	9.	Sorting and feeding mechanisms	SF	3239 through 3256

Table 1 (continued)

Group No.	XXI			
Group name	Cam-Lever Mechanisms			
Group index	CmL			
	No.	Name	Sub-group index	Mechanism No.
	10.	Mechanisms of materials handling equipment	MH	3257
	11.	Mechanisms of measuring and testing devices	M	3258, 3259 and 3260
	12.	Clutch and coupling mechanisms	C	3261 and 3262
	13.	Piston machine mechanisms	PM	3263 through 3266
	14.	Switching, engaging and disengaging mechanisms	SE	3267, 3268 and 3269
	15.	Mechanisms of other functional devices	FD	3270 through 3297
Group No.	XXII			
Group name	Gear-Cam Mechanisms			
Group index	GrC			
	No.	Name	Sub-group index	Mechanism No.
	1.	General-purpose multiple-link mechanisms	ML	3298 through 3316
	2.	Dwell mechanisms	D	3317 through 3323
	3.	Mechanisms for generating curves	Ge	3324
	4.	Mechanisms for mathematical operations	MO	3325 through 3328
	5.	Operating claw mechanisms of motion picture cameras	OC	3329 through 3332
	6.	Piston machine mechanisms	PM	3333
	7.	Indexing mechanisms	I	3334

Table 1 (continued)

Group No.	XXII			
Group name	Gear-Cam Mechanisms			
Group index	GrC			
	No.	Name	Sub-group index	Mechanism No.
	8.	Link-length adjustment mechanisms	LL	3335
	9.	Mechanisms of other functional devices	FD	3336 through 3340
Group No.	XXIII			
Group name	Cam-Ratchet Mechanisms			
Group index	CR			
	No.	Name	Sub-group index	Mechanism No.
	1.	General-purpose multiple-link mechanisms	ML	3341 through 3347
	2.	Dwell mechanisms	D	3348
	3.	Switching, engaging and disengaging mechanisms	SE	3349
	4.	Link-length adjustment mechanisms	LL	3350 and 3351
	5.	Piston machine mechanisms	PM	3352
	6.	Sorting and feeding mechanisms	SF	3353 and 3354
	7.	Mechanisms of other functional devices	FD	3355 through 3359
Group No.	XXIV			
Group name	Simple Friction Mechanisms			
Group index	SmF			
	No.	Name	Sub-group index	Mechanism No.
	1.	General-purpose three-link mechanisms	3L	3360 through 3369
	2.	General-purpose multiple-link mechanisms	ML	3370 through 3376

Table 1 (continued)

Group No.	XXIV			
Group name	Simple Friction Mechanisms			
Group index	SmF			
	No.	Name	Sub-group index	Mechanism No.
	3.	Brake mechanisms	Br	3377 through 3391
	4.	Stop, detent and locking mechanisms	SD	3392 through 3396
	5.	Sorting and feeding mechanisms	SF	3397 through 3400
	6.	Clutch and coupling mechanisms	C	3401 through 3412
	7.	Governor mechanisms	G	3413
	8.	Gripping, clamping and expanding mechanisms	GC	3414
	9.	Mechanisms of other functional devices	FD	3415 and 3416
Group No.	XXV			
Group name	Complex Friction Mechanisms			
Group index	CF			
	No.	Name	Sub-group index	Mechanism No.
	1.	General-purpose multiple-link mechanisms	ML	3417 through 3431
	2.	Mechanisms for generating curves	Ge	3432
	3.	Mechanisms for mathematical operations	MO	3433 through 3442
	4.	Mechanisms for measuring and testing devices	M	3443, 3444 and 3445
	5.	Dwell mechanisms	D	3446 and 3447
	6.	Sorting and feeding mechanisms	SF	3448
	7.	Clutch and coupling mechanisms	C	3449 through 3453
	8.	Switching, engaging and disengaging mechanisms	SE	3454

Table 1 (continued)

Group No.	XXV			
Group name	Complex Friction Mechanisms			
Group index	CF			
	No.	Name	Sub-group index	Mechanism No.
	9.	Governor mechanisms	G	3455, 3456 and 3457
	10.	Hammer, press and die mechanisms	HP	3458 and 3459
	11.	Infinitely variable transmission mechanisms	IV	3460 through 3478
Group No.	XXVI			
Group name	Simple Flexible-Link Mechanisms			
Group index	SFL			
	No.	Name	Sub-group index	Mechanism No.
	1.	General-purpose four-link mechanisms	4L	3479 through 3492
	2.	General-purpose multiple-link mechanisms	ML	3493 through 3503
	3.	Belt drive mechanisms	BD	3504 through 3517
	4.	Mechanisms of materials handling equipment	MH	3518 through 3521
	5.	Mechanisms of measuring and testing devices	M	3522 through 3526
	6.	Brake mechanisms	Br	3527 and 3528
	7.	Mechanisms of other functional devices	FD	3529, 3530 and 3531
Group No.	XXVII			
Group name	Complex Flexible-Link Mechanisms			
Group index	CFL			
	No.	Name	Sub-group index	Mechanism No.
	1.	General-purpose multiple-link mechanisms	ML	3532 through 3551

Table 1 (continued)

Group No.	XXVII			
Group name	Complex Flexible-Link Mechanisms			
Group index	CFL			
	No.	Name	Sub-group index	Mechanism No.
	2.	Mechanisms for mathematical operations	MO	3552 and 3553
	3.	Switching, engaging and disengaging mechanisms	SE	3554, 3555 and 3556
	4.	Mechanisms of materials handling equipment	MH	3557 through 3562
	5.	Mechanisms for generating curves	Ge	3563 and 3564
	6.	Mechanisms for measuring and testing devices	M	3565
	7.	Differential flexible-link mechanisms	DF	3566 through 3583
	8.	Mechanisms of other functional devices	FD	3584 through 3590

No.	Sub-group index	Subgroup name	Group			
			SmC	CmL	GrC	
1.	BD	Belt drive mechanisms				
2.	Br	Brake mechanisms	3126 through 3130			
3.	C	Clutch and coupling mechanisms	3121 through 3125	3261 and 3262		
4.	D	Dwell mechanisms		3191 through 3195	3317 through 3323	
5.	DF	Differential flexible-link mechanisms				
6.	FD	Mechanisms of other functional devices	3156 through 3171	3270 through 3297	3336 through 3340	
7.	G	Governor mechanisms	3148			
8.	GC	Gripping, clamping and expanding mechanisms	3149 through 3152	3224 through 3229		
9.	Ge	Mechanisms for generating curves	3115	3196 through 3198	3324	

Table 2

BASED ON FUNCTIONAL FEATURES

index				
CR	SmF	CF	SFL	CFL
			3504 through 3517	
	3377 through 3391		3527 and 3528	
	3401 through 3412	3449 through 3453		
3348		3446 and 3447		
				3566 through 3583
3355 through 3359	3415 and 3416		3529 through 3531	3584 through 3590
	3413	3455 through 3457		
	3414			
		3432		3563 and 3564

No.	Sub-group index	Subgroup name	Group			
			SmC	CmL	GrC	
10.	HP	Hammer, press and die mechanisms	3145 through 3147	3218 through 3223		
11.	I	Indexing mechanisms	3153		3334	
12.	IV	Infinitely variable transmission mechanisms				
13.	3L	General-purpose three-link mechanisms	2978 through 3061			
14.	4L	General-purpose four-link mechanisms	3062 through 3069			
15.	LL	Link-length adjustment mechanisms	3131 through 3144	3230 through 3238	3335	
16.	M	Mechanisms of measuring and testing devices		3258 through 3260		
17.	MH	Mechanisms of materials handling equipment		3527		
18.	ML	General-purpose multiple-link mechanisms	3070 through 3099	3172 through 3190	3298 through 3316	
19.	MO	Mechanisms for mathematical operations	3116 through 3120	3199 through 3205	3325 through 3328	

Table 2 (continued)

index				
CR	SmF	CF	SFL	CFL
		3458 and 3459		
		3460 through 3478		
	3360 through 3369			
			3479 through 3492	
3350 and 3351				
		3443 through 3445	3522 through 3526	3565
			3518 through 3521	3557 through 3562
3341 through 3347	3370 through 3376	3417 through 3431	3493 through 3503	3532 through 3551
		3433 through 3442		3552 and 3553

No.	Sub-group index	Subgroup name	Group		
			SmC	CmL	GrC
20.	OC	Operating claw mechanisms of motion picture cameras	3105 through 3112	3206 through 3217	3329 through 3332
21.	PM	Piston machine mechanisms	3154	3263 through 3266	3333
22.	SD	Stop, detent and locking mechanisms			
23.	SE	Switching, engaging and disengaging mechanisms	3100 through 3104	3267 through 3269	
24.	SF	Sorting and feeding mechanisms	3155	3239 through 3256	
25.	VM	Mechanisms of vibrating machines and devices	3113 and 3114		

Table 2 (continued)

Index					
	CR	SmF	CF	SFL	CFL
	3352				
		3392 through 3396			
	3349		3454		3554 through 3556
	3353 and 3354	3397 through 3400	3348		

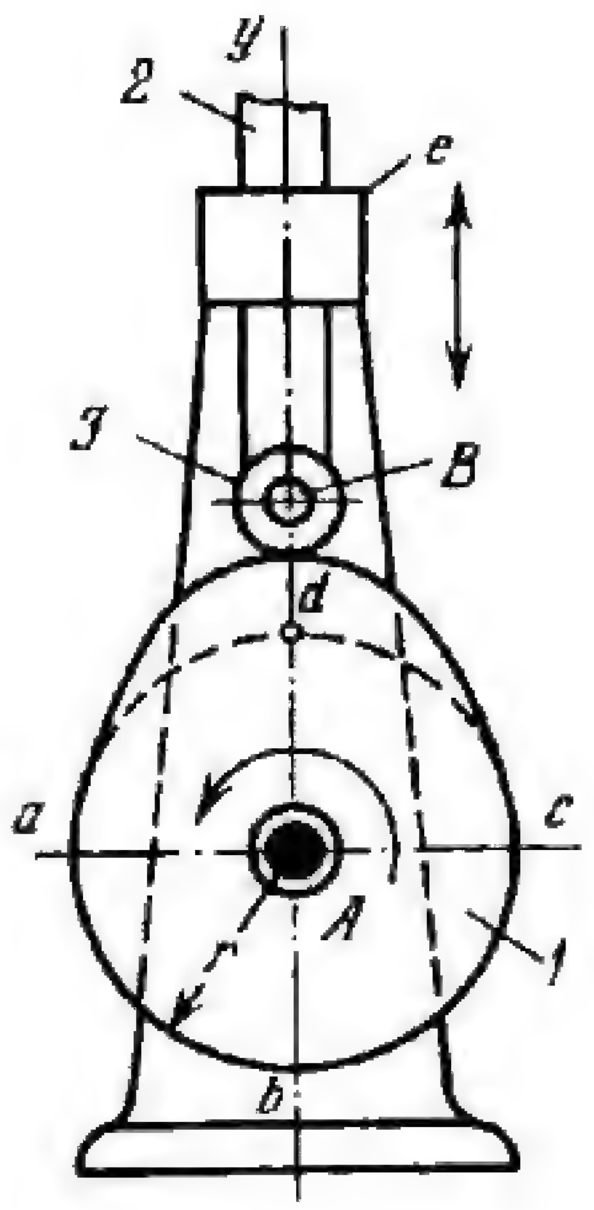
SECTION TWENTY

Simple Cam Mechanisms SmC

1. General-Purpose Three-Link Mechanisms 3L (2978 through 3061)
2. General-Purpose Four-Link Mechanisms 4L (3062 through 3069)
3. General-Purpose Multiple-Link Mechanisms ML (3070 through 3099)
4. Switching, Engaging and Disengaging Mechanisms SE (3100 through 3104)
5. Operating Claw Mechanisms of Motion Picture Cameras OC (3105 through 3112)
6. Mechanisms of Vibrating Machines and Devices VM (3113 and 3114)
7. Mechanisms for Generating Curves Ge (3115)
8. Mechanisms for Mathematical Operations MO (3116 through 3120)
9. Clutch and Coupling Mechanisms C (3121 through 3125)
10. Brake Mechanisms Br (3126 through 3130)
11. Link-Length Adjustment Mechanisms LL (3131 through 3144)
12. Hammer, Press and Die Mechanisms HP (3145, 3146 and 3147)
13. Governor Mechanisms G (3148)
14. Gripping, Clamping and Expanding Mechanisms GC (3149 through 3152)
15. Indexing Mechanisms I (3153)
16. Piston Machine Mechanisms PM (3154)
17. Sorting and Feeding Mechanisms SF (3155)
18. Mechanisms of Other Functional Devices FD (3156 through 3171)

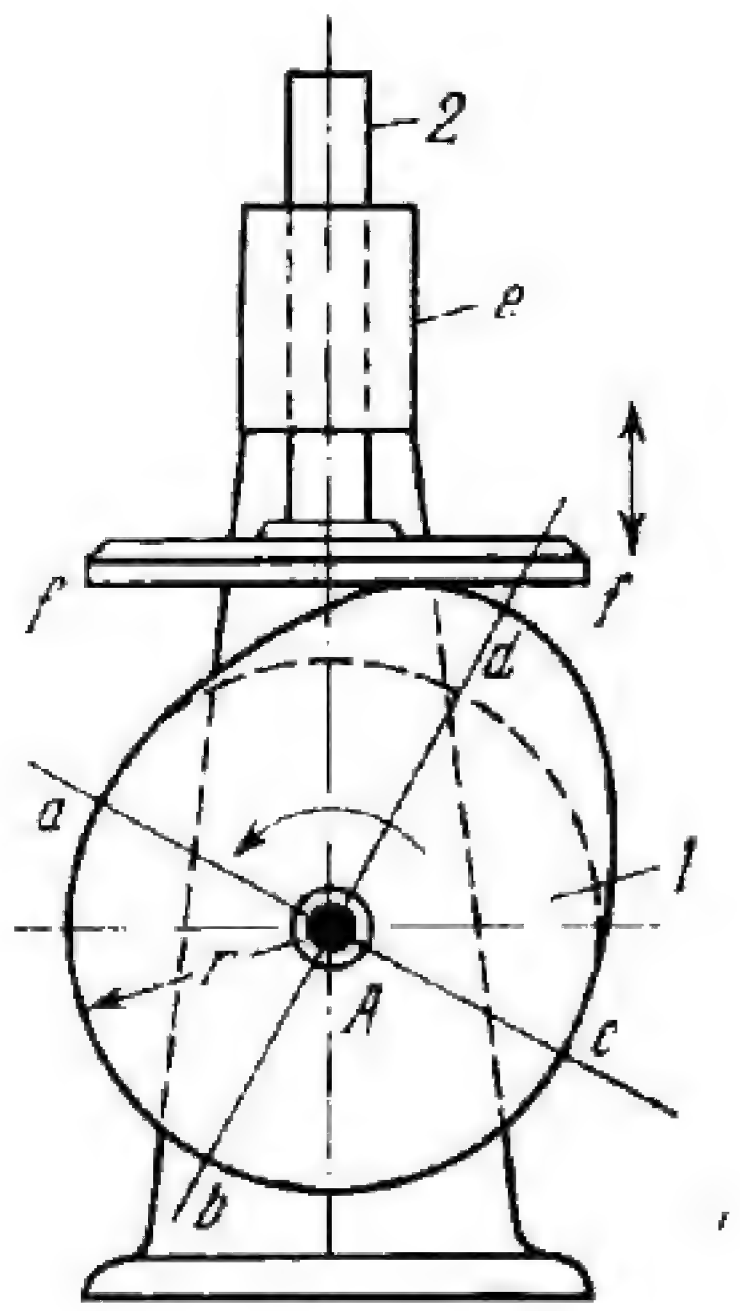
1. GENERAL-PURPOSE THREE-LINK MECHANISMS
(2978 through 3061)

2978	THREE-LINK PLATE CAM MECHANISM WITH A RECIPROCATING ROLLER FOLLOWER	SmC 3L



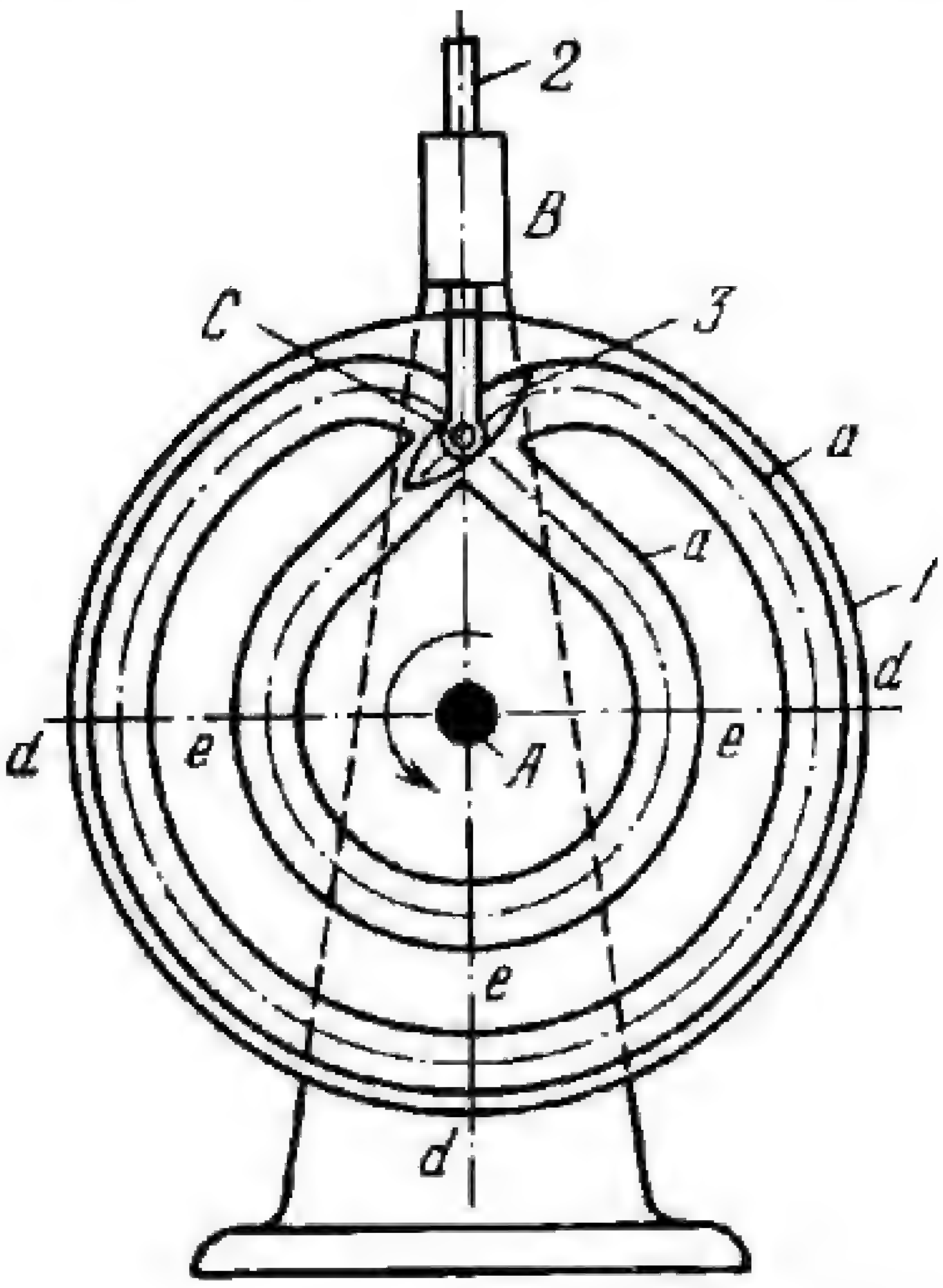
Cam *1* rotates about fixed axis *A* and its contour along portion *abc* is a circular arc of radius *r*. Follower *2* reciprocates in fixed guide *e* and carries roller *3* which rotates freely about axis *B*. Axis *By* of follower motion passes through axis *A* of cam rotation. Follower *2* has its rise when roller *3* contacts portion *ad* of the contour of cam *1* and its return on portion *dc*. Follower *2* has a dwell while roller *3* contacts portion *abc*.

2979	THREE-LINK PLATE CAM MECHANISM WITH A RECIPROCATING FLAT-FACED FOLLOWER	SmC 3L



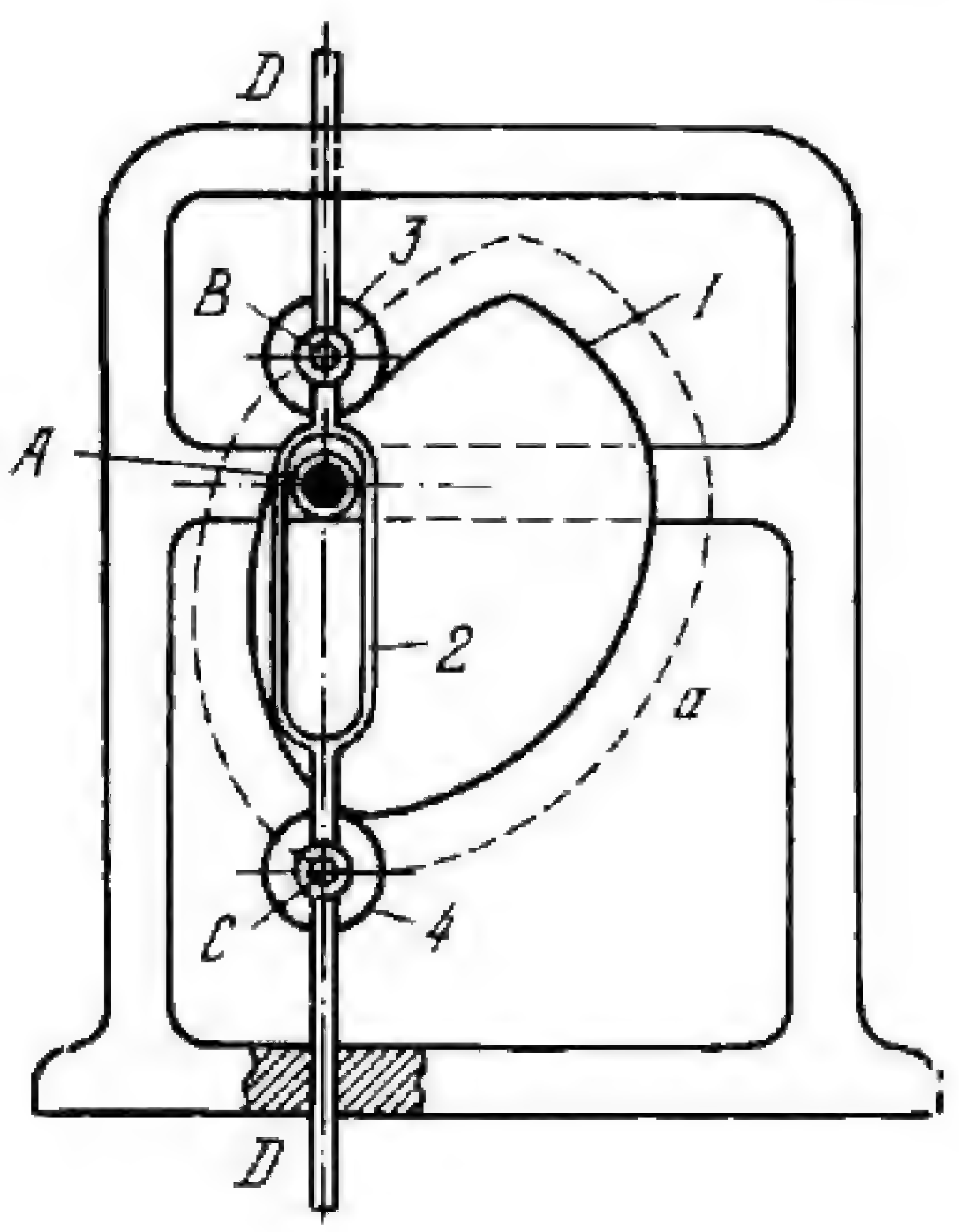
Cam *1* rotates about fixed axis *A* and its contour along portion *abc* is a circular arc of radius *r*. Follower *2* reciprocates in fixed guide *e* and has flat surface *f-f* tangent to the contour of cam *1*. The axis of follower motion passes through axis *A* of cam rotation. Follower *2* has its rise when flat surface *f-f* contacts portion *ad* of the contour of cam *1* and its return on portion *dc*. Follower *2* has a dwell while surface *f-f* contacts portion *abc*.

2980	THREE-LINK CROSS-GROOVED FACE CAM MECHANISM	SmC 3L



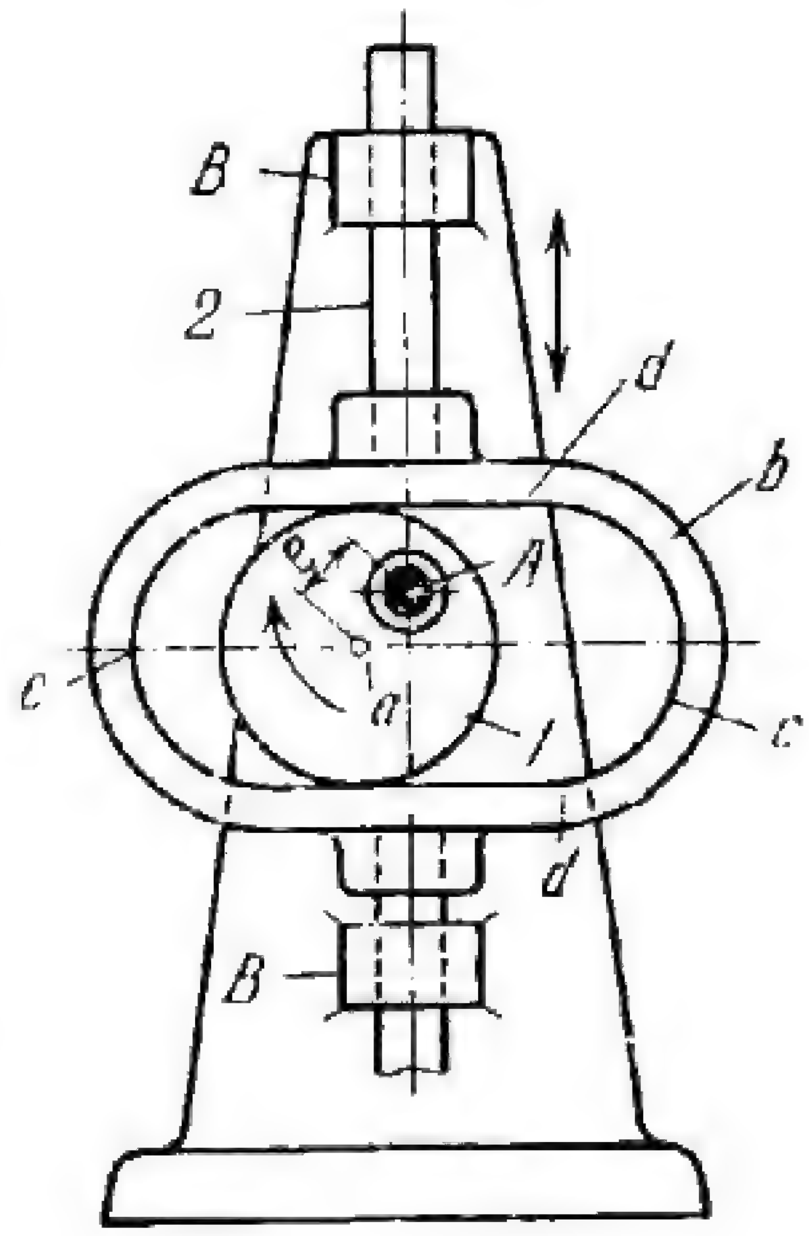
Cam *1* rotates about fixed axis *A* and has cam groove *a* whose pitch curve has point *C* of self-intersection. Follower *2* reciprocates in fixed guide *B* and carries pivoted lens-shaped member *3* which slides along groove *a*. In one cycle of motion, equal to two revolutions of cam *1*, the follower has two rises with different types of motion and two returns with different types of motion. Follower *2* has dwells while member *3* slides along circular concentric portions *d-d* and *e-e* of groove *a*. At point *C* of self-intersection, member *3* passes from one part of the groove to the other due to its lens shape.

2981	THREE-LINK CONSTANT-DIAMETER CAM MECHANISM	SmC 3L



Cam *1* rotates about fixed axis *A*. Follower *2* reciprocates in fixed guides *D-D* and carries two round rollers *3* and *4*. Positive motion is achieved by designing pitch, or theoretical, curve *a* of cam *1* with a constant diameter, i.e. the length of any diameter of curve *a*, passing through centre *A*, is equal to distance $\overline{CB}$ between the centres of rollers *4* and *3*.

2982	THREE-LINK CONSTANT-BREADTH CAM MECHANISM	SmC 3L



Cam *1*, a round eccentric, rotates about fixed axis *A*, located at the distance *e* from geometrical centre *a* of the cam. Follower *2* reciprocates in fixed guides *B-B* and has yoke *b* consisting of two flat faces *d* and two circular portions *c*. When cam *1* rotates, follower *2* has harmonic motion according to the equation

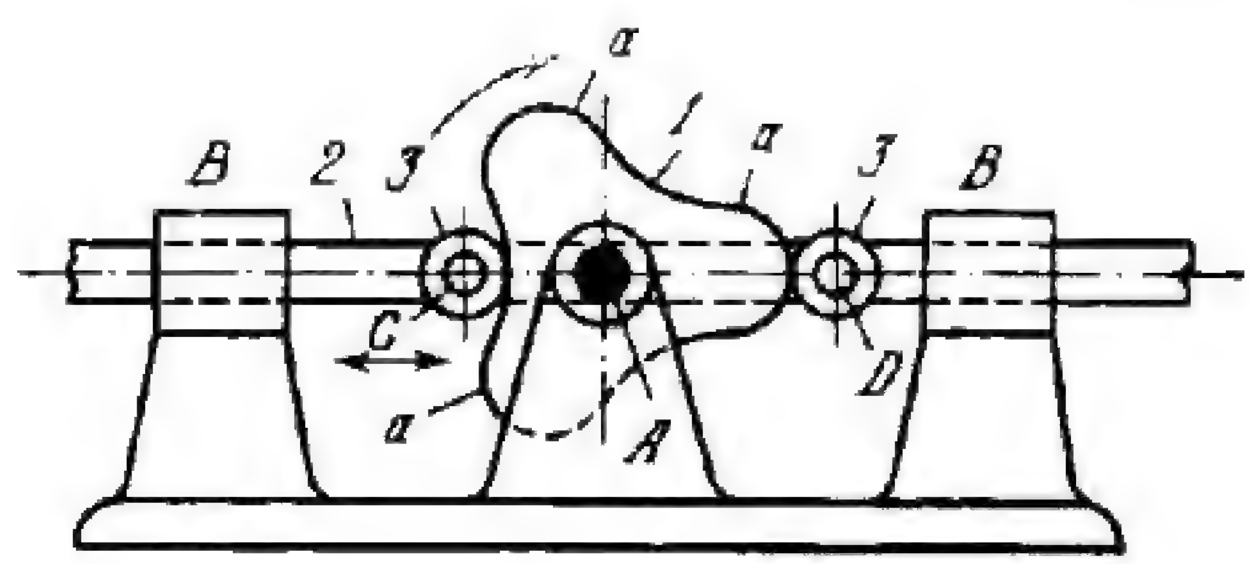
$$s_2 = e \sin \varphi$$

where s_2 is the displacement of follower *2*, *e* is the eccentricity of cam *1* and φ is the angle of cam rotation. The corresponding velocity and acceleration of the follower are

$$v_2 = \omega e \cos \varphi \quad \text{and} \quad a_2 = -\omega^2 e \sin \varphi$$

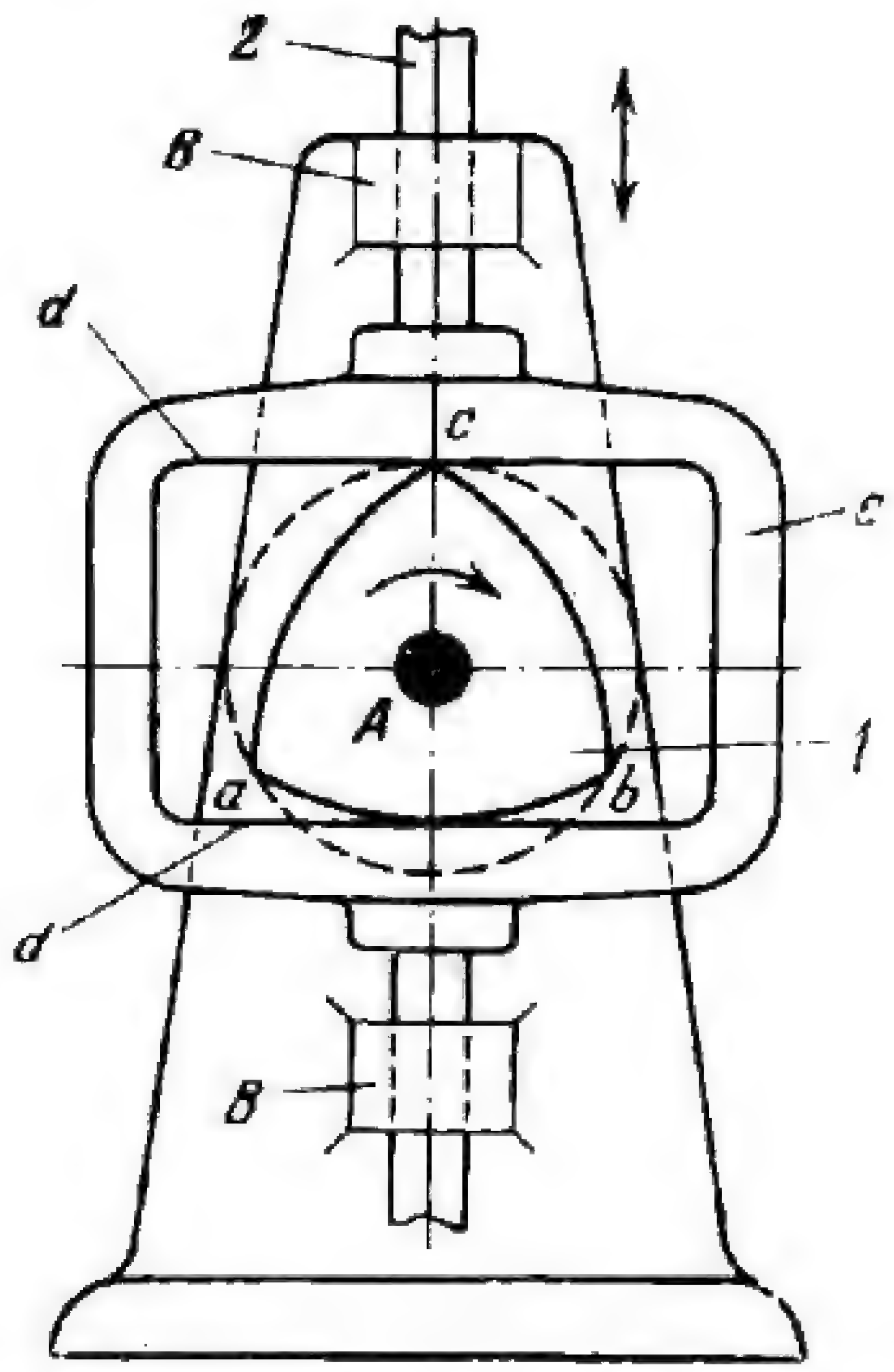
where ω is the angular velocity of cam *1*. Follower *2* has instantaneous dwells when cam *1* contacts portions *c* of yoke *b*. Positive motion is achieved because the diameter of cam *1* equals the distance between flat faces *d* (breadth) of yoke *b*.

2983	THREE-LINK THREE-LOBE CONSTANT-DIAMETER CAM MECHANISM	SmC 3L



Cam *1* rotates about fixed axis *A* and has three profiled lobes *a* composed of tangent circular arcs. Follower *2* reciprocates in fixed guides *B-B* and carries two rollers *3* which contact lobes *a* of the cam. Positive motion is achieved because all diameters of the pitch, or theoretical, curve of the cam, passing through centre *A*, are equal to distance $\overline{CD}$ between the centres of rollers *3*. In one cycle, follower *2* has three rises and three returns.

2984	THREE-LINK THREE-LOBE CONSTANT-BREADTH CAM MECHANISM	SmC 3L



Cam *1* rotates about fixed axis *A* and has a contour composed of three circular arcs described from centres *a*, *c* and *b* which lie on a circle described from point *A*. Points *a*, *c* and *b* are the vertexes of equilateral triangle *acb*. Follower *2* reciprocates in fixed guides *B-B* and has yoke *e* consisting of two flat faces *d*. When cam *1* rotates, follower *2* has harmonic motion according to the equation

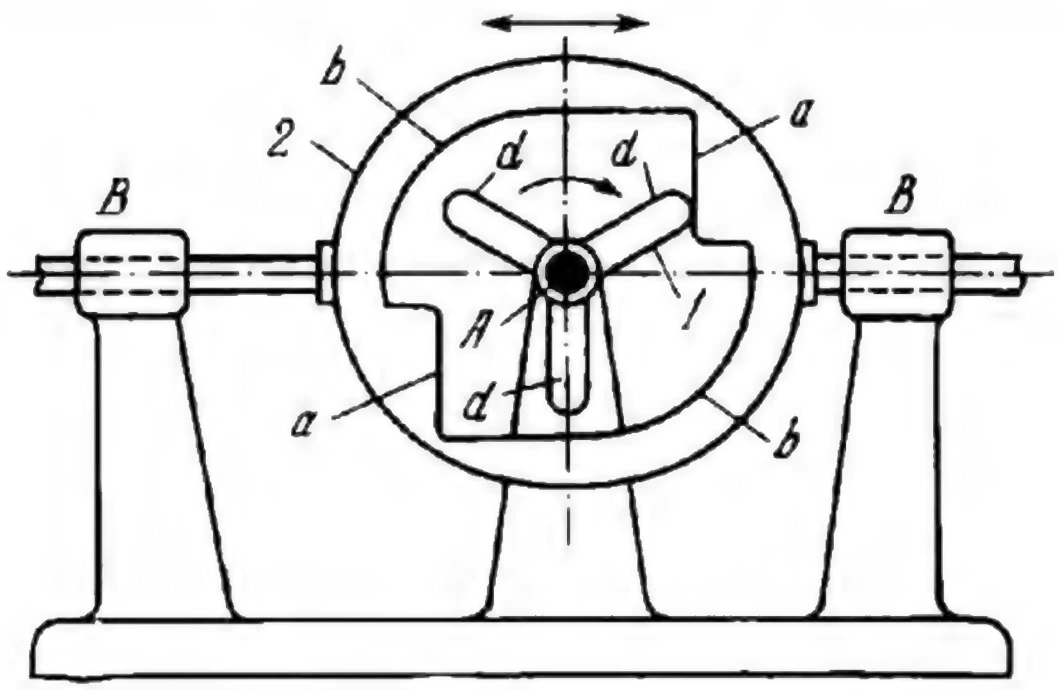
$$s_2 = r \sin \varphi$$

where s_2 is the displacement of follower *2*, r is the constant diameter of the cam and φ is the angle of cam rotation. The corresponding velocity and acceleration of the follower are

$$v_2 = \omega r \cos \varphi \quad \text{and} \quad a_2 = -\omega^2 r \sin \varphi$$

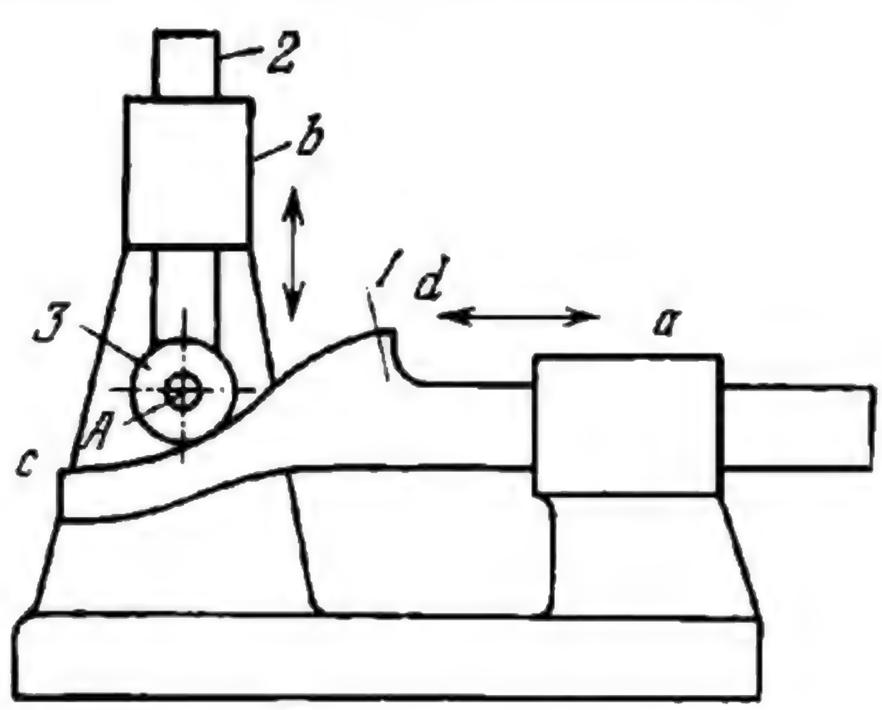
where ω is the angular velocity of cam *1*. In one cycle, follower *2* has three rises and three returns. The follower has instantaneous dwells when points *a*, *c* and *b* contact flat faces *d* of yoke *e*. Positive motion is achieved because cam *1* is of constant diameter equal to the distance between faces *d* (breadth) of yoke *e*.

2985	THREE-LINK TRIPLE-FINGER CAM MECHANISM	SmC 3L



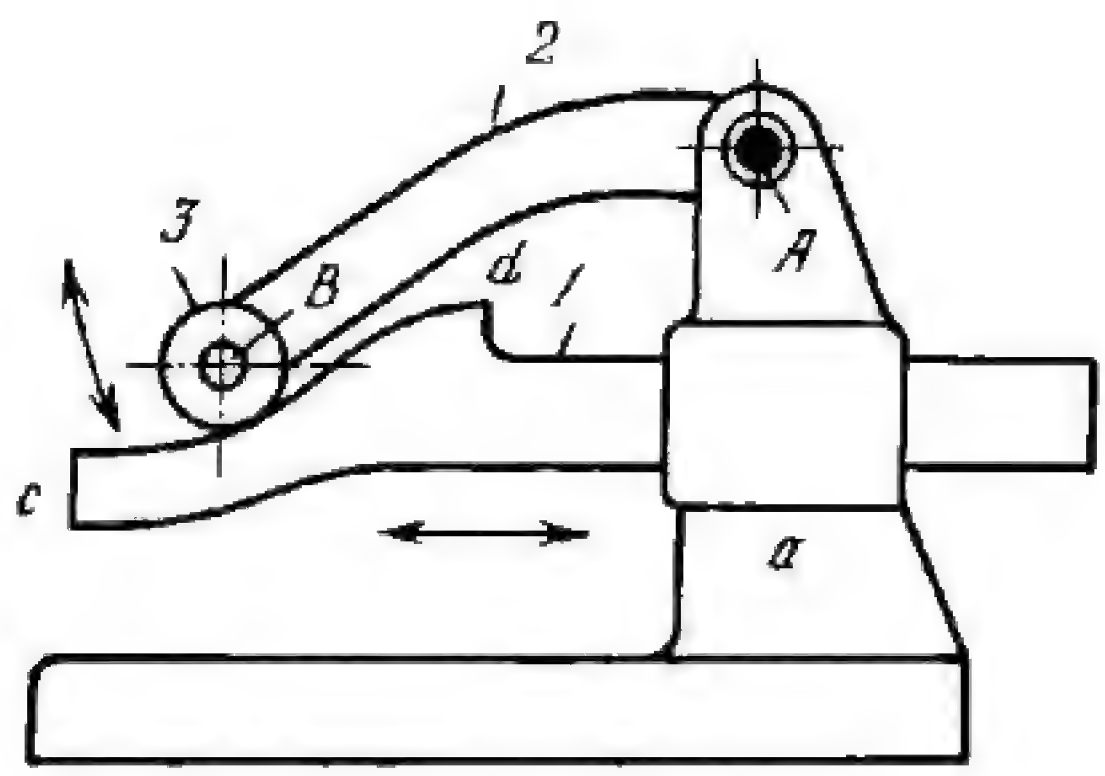
Cam *1* rotates about fixed axis *A* and consists of three equally spaced fingers *d* with semicircular tips. Follower *2* reciprocates in fixed guides *B-B* and its inner profile has two flat faces *a*. Pins *d* can contact only flat faces *a*. Surfaces *b* are designed to clear fingers *d*. In one cycle, follower *2* has three rises and three returns with long dwells at the extreme positions. The mechanism operates with impacts at the instants fingers *d* come into contact with faces *a*.

2986	THREE-LINK RECIPROCATING-FOLLOWER SLIDING CAM MECHANISM	SmC 3L



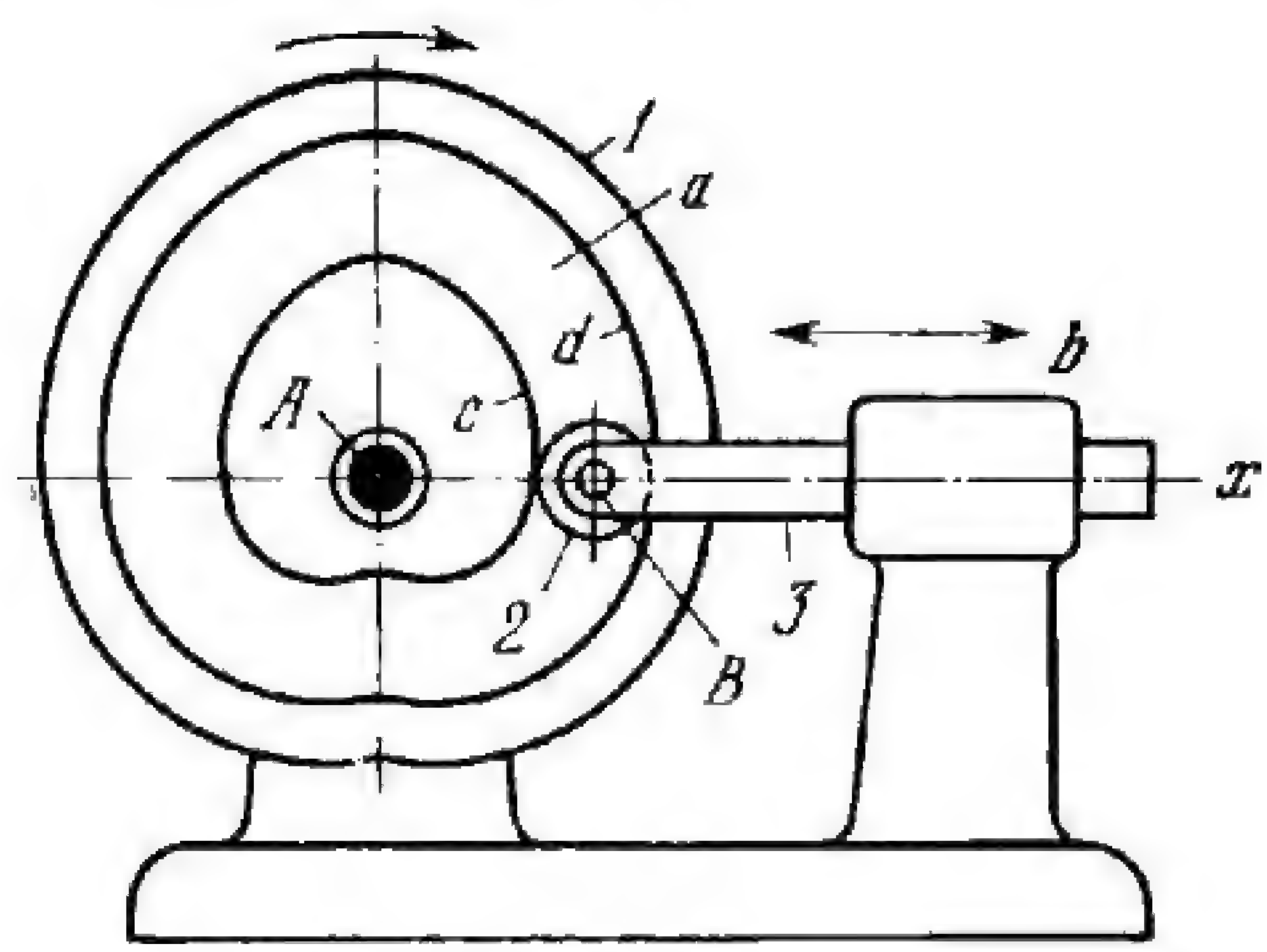
Cam *1* with profile *cd* reciprocates in fixed guide *a*. Follower *2* reciprocates in fixed guide *b* and carries roller *3* which rotates freely about axis *A*. Follower rise occurs when cam *1* moves to the left, and return when the cam moves to the right.

2987	THREE-LINK OSCILLATING-FOLLOWER SLIDING CAM MECHANISM	SmC 3L



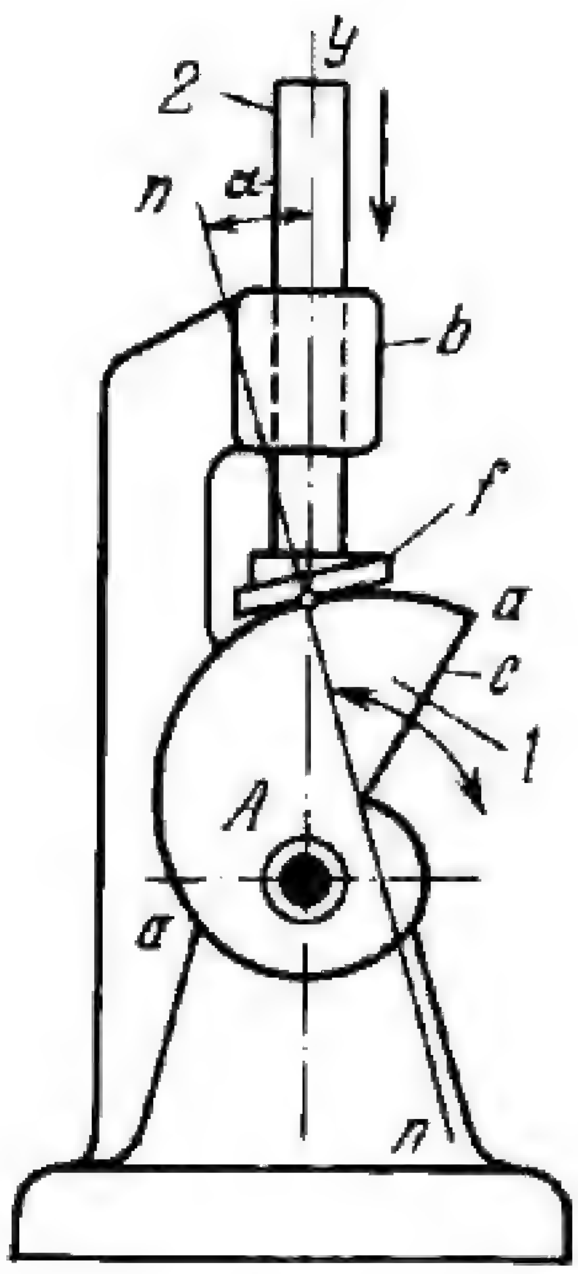
Cam *1* with profile *cd* reciprocates in fixed guide *a*. Follower *2* oscillates about fixed axis *A* and carries roller *3* which rotates freely about axis *B*. Follower rise occurs when cam *1* moves to the left, and return when the cam moves to the right.

2988	THREE-LINK RECIPROCATING-FOLLOWER FACE CAM MECHANISM	SmC 3L



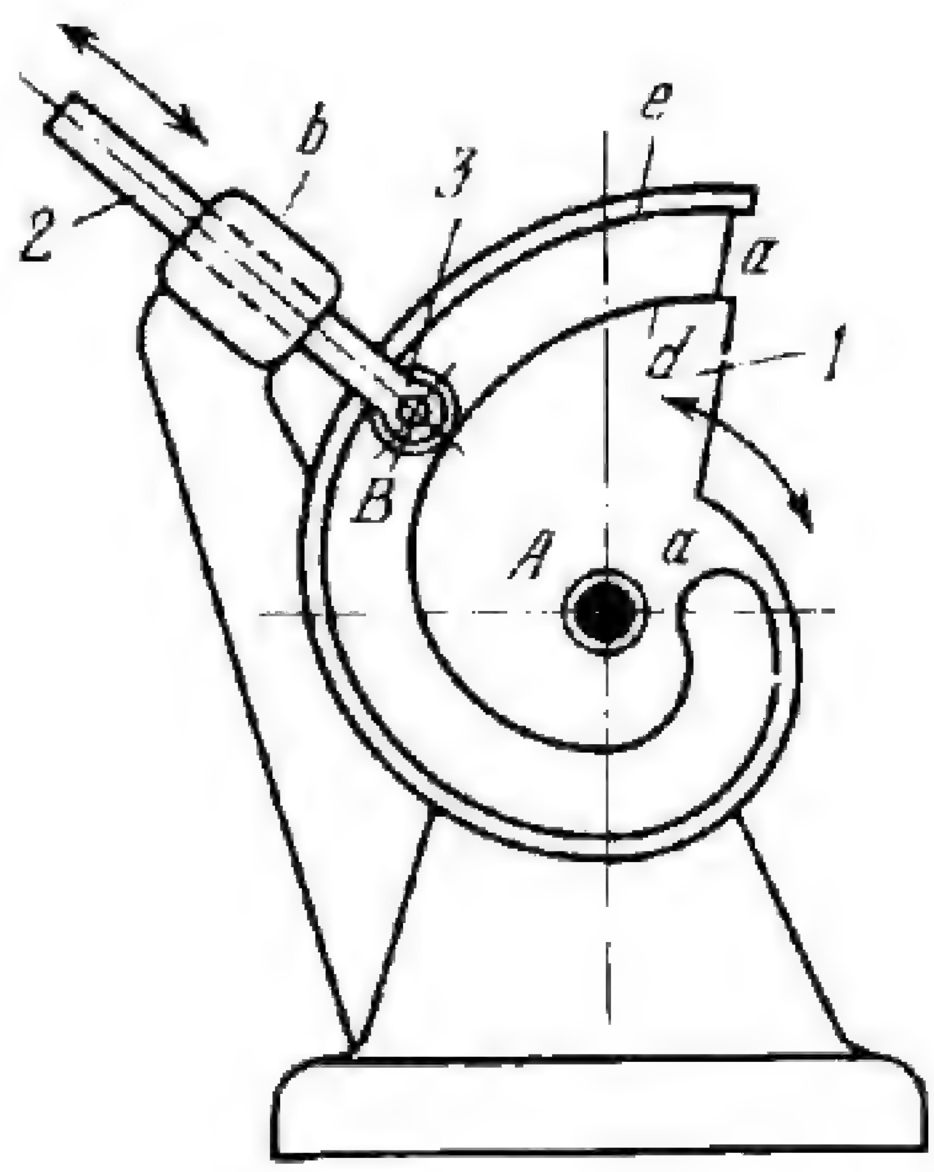
Cam *1* rotates about fixed axis *A* and has profiled groove *a* in which roller *2* slides and rolls. Follower *3* reciprocates in fixed guide *b* and carries roller *2* which rotates freely about axis *B*. Axis *Bx* of follower motion passes through axis *A* of cam rotation. Positive motion is achieved because roller *2* is confined between side surfaces *c* and *d* of groove *a*.

2989	THREE-LINK SPIRAL CAM MECHANISM WITH A RECIPROCATING FLAT-FACED FOLLOWER	SmC 3L



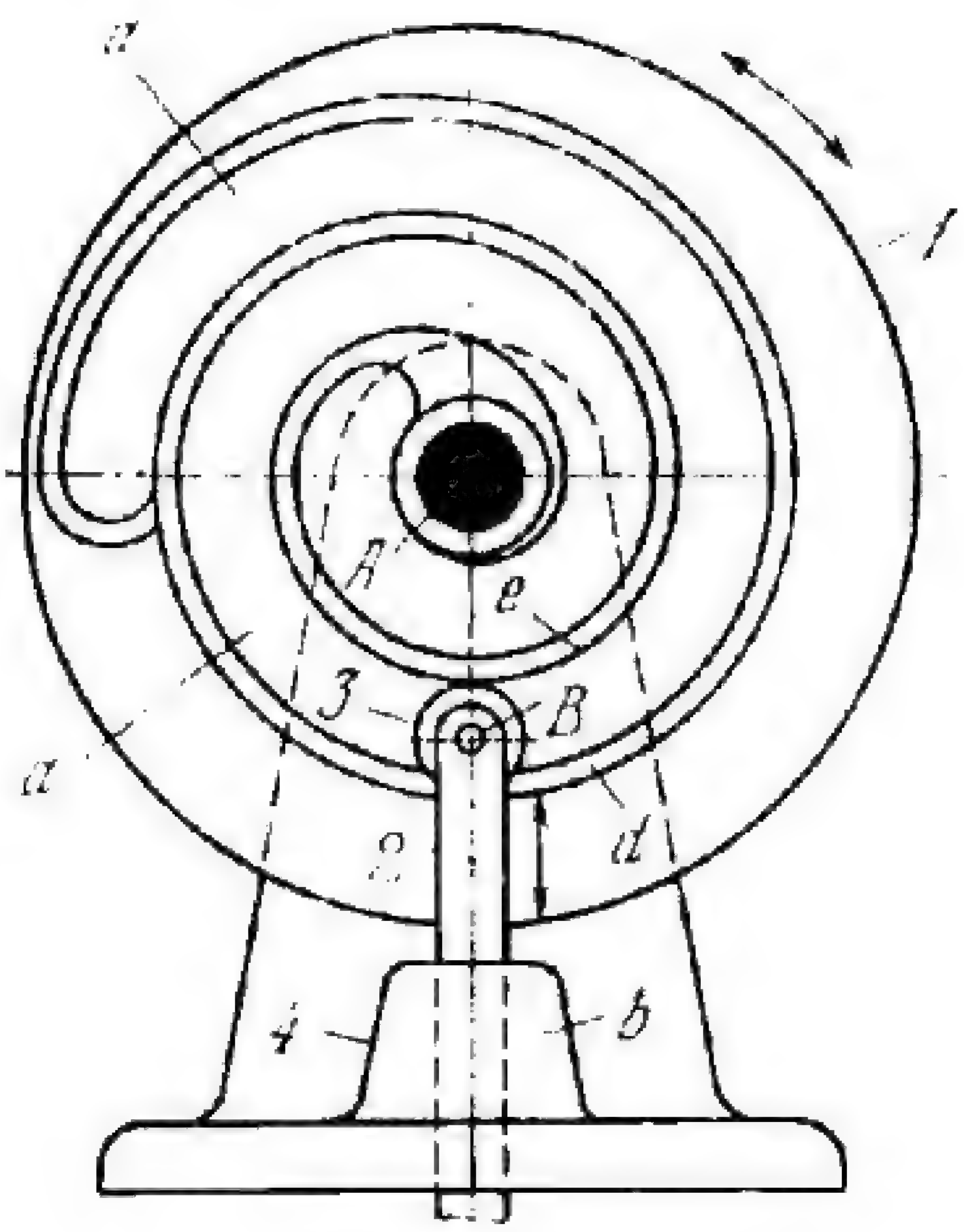
Cam *1* rotates about fixed axis *A* and has profile *a-a* along a logarithmic spiral. Follower *2* reciprocates in fixed guide *b* and has flat surface *f* which is tangent to profile *a-a* of cam *1*. Pressure angle α, between normal *n-n* to the cam surface and axis *Ay* of follower motion, is constant for the given profile. When cam *1* rotates continuously counterclockwise, follower *2* has a period of free fall in each revolution. The mechanism is stopped when cam *1* begins to rotate clockwise and face *c* of the cam runs up against follower *2*.

2990	THREE-LINK SPIRAL FACE CAM MECHANISM WITH A ROLLER FOLLOWER	SmC 3L



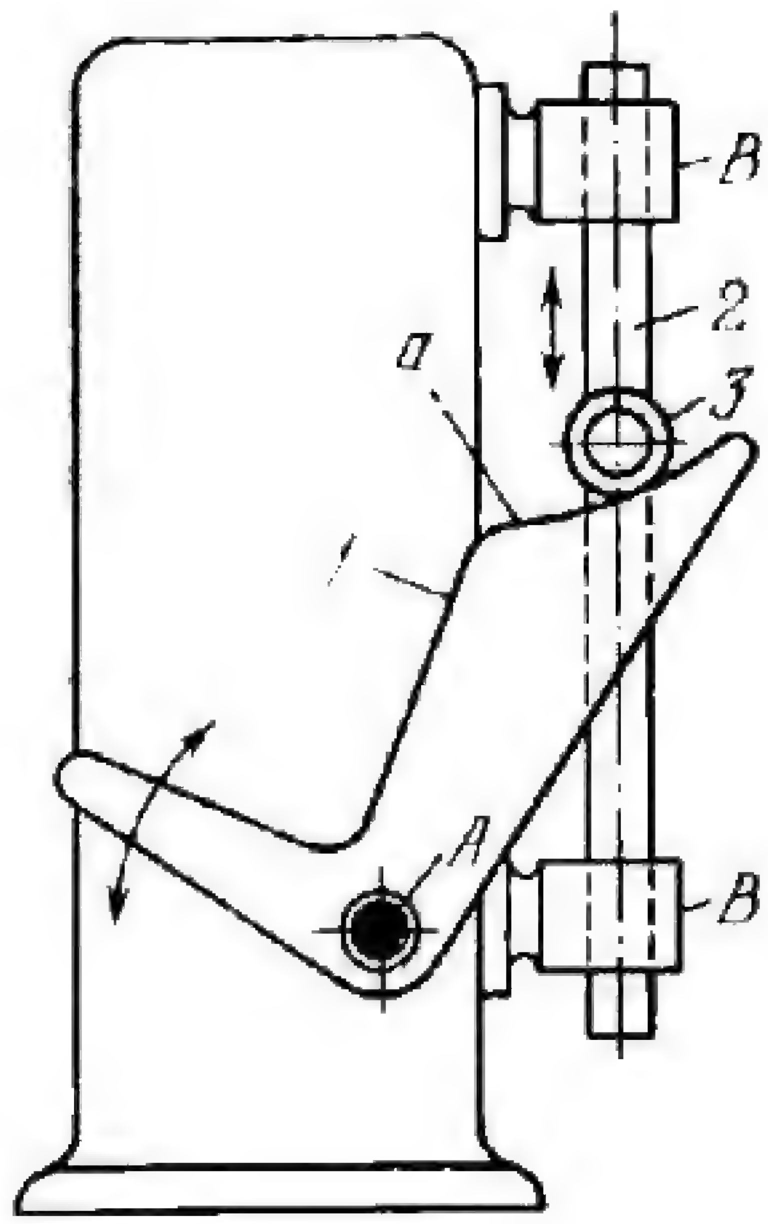
Cam *1* turns about fixed axis *A* and has profiled groove *a-a*. Follower *2* reciprocates in fixed guide *b* and carries roller *3* which rotates freely about axis *B* and slides and rolls along groove *a-a*. Positive motion is achieved because roller *3* is confined between side surfaces *d* and *e* of groove *a-a*. When cam *1* oscillates, follower *2* reciprocates.

2991	THREE-LINK SPIRAL FACE CAM MECHANISM WITH A ROLLER FOLLOWER	SmC 3L



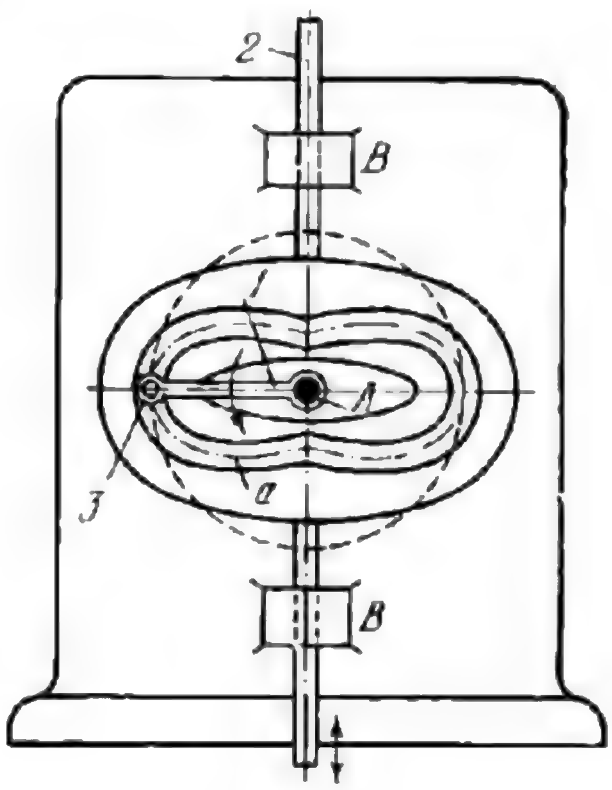
Cam *1* turns about fixed axis *A* and has groove *a-a* along a logarithmic spiral. Follower *2* reciprocates in fixed guide *b* and carries roller *3* which rotates freely about axis *B* and slides and rolls along groove *a-a*. Positive motion is achieved because roller *3* is confined between side surfaces *d* and *e* of groove *a-a*. Cam *1* oscillates through an angle of 720° about axis *A*. Within these limits, equal angles of rotation of cam *1* correspond to equal displacements of follower *2*.

2992	THREE-LINK OSCILLATING CAM MECHANISM	SmC 3L



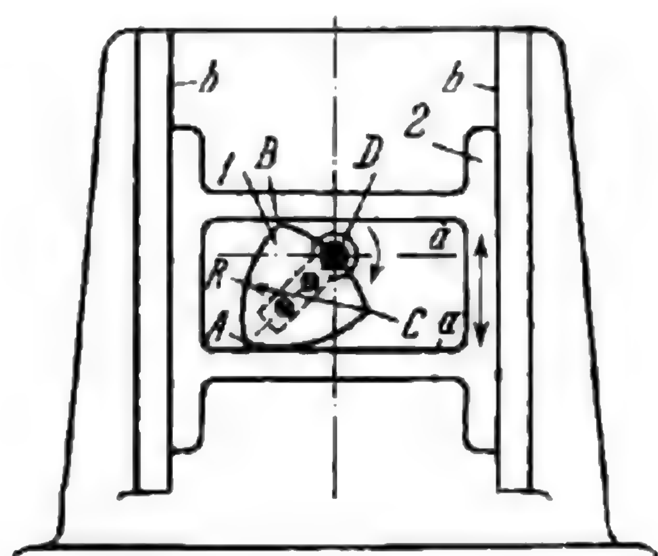
Cam *1* oscillates about fixed axis *A*. Follower *2* reciprocates in fixed guides *B-B* and carries roller *3* which rolls along profile *a* of cam *1*. Roller *3* is held in contact with cam *1* by a spring (not shown).

2993	THREE-LINK INVERSE FACE CAM MECHANISM	SmC 3L



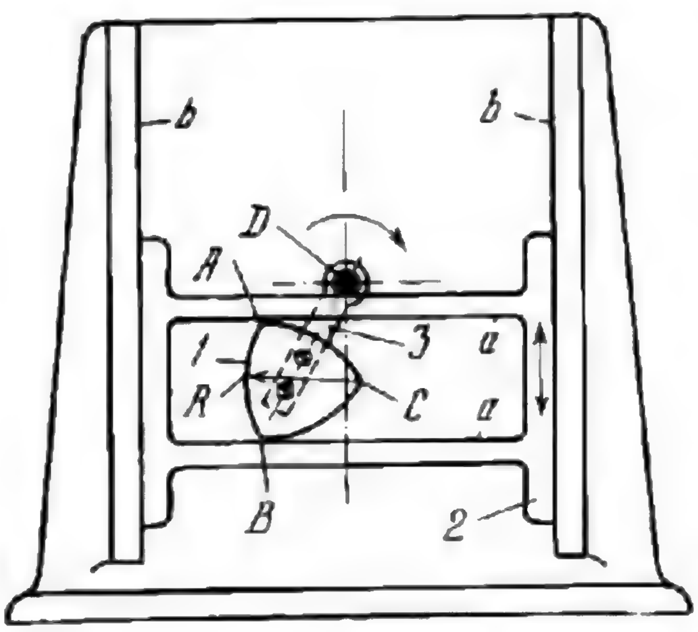
Driver *1* rotates about fixed axis *A* and carries roller *3* which slides and rolls along groove *a* of cam *2*. Cam *2* reciprocates in fixed guides *B*-*B*. The theoretical, or pitch, curve of groove *a* is designed so that follower *2* rises and returns at constant velocity.

2994	THREE-LINK THREE-LOBE CONSTANT-BREADTH CAM MECHANISM	SmC 3L



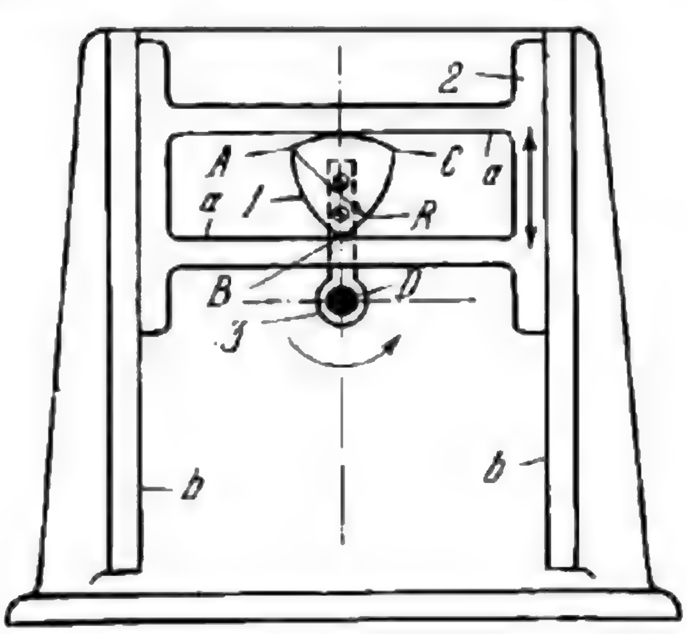
Cam *1* rotates about fixed axis *D* and has a contour composed of three circular arcs of radius *R* described from points *A*, *B* and *C*. Follower (slide) *2* reciprocates in fixed guides *b*-*b* and has a yoke with the distance (breadth) *R* between flat faces *a* which confine cam *1*. Positive motion is achieved because all the diameters of cam *1* equal *R*. If axis *D* is located in the middle of arc *BC*, slide *2* has a stroke equal to 2*R*. Slide *2* has harmonic motion with instantaneous dwells at the extreme positions.

2995	THREE-LINK THREE-LOBE CONSTANT-BREADTH CAM MECHANISM	SmC 3L



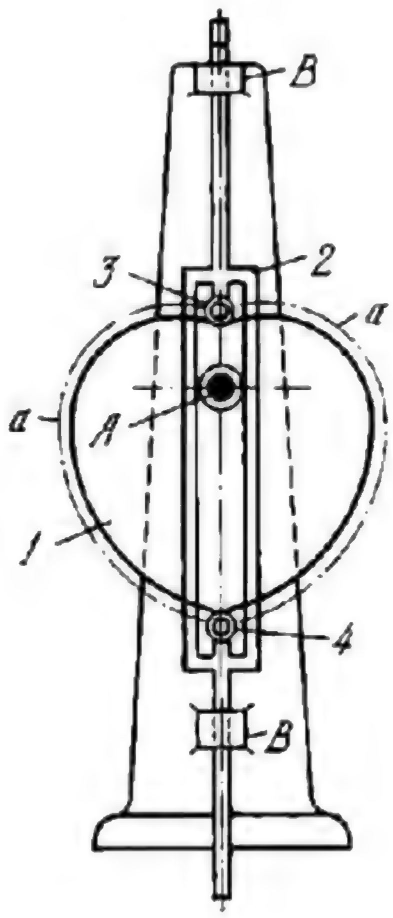
Cam *1* is rigidly attached to crank *3* which rotates about fixed axis *D*. Cam *1* has a contour composed of three circular arcs of radius *R* described from points *A*, *B* and *C*. Follower (slide) *2* reciprocates in fixed guides *b-b* and has a yoke with the distance (breadth) *R* between flat faces *a* which confine cam *1*. Positive motion is achieved because all the diameters of cam *1* equal *R*. The stroke of slide *2* equals $2\overline{DB} - R$. Slide *2* has harmonic motion with instantaneous dwells at the extreme positions.

2996	THREE-LINK THREE-LOBE CONSTANT-BREADTH CAM MECHANISM	SmC 3L



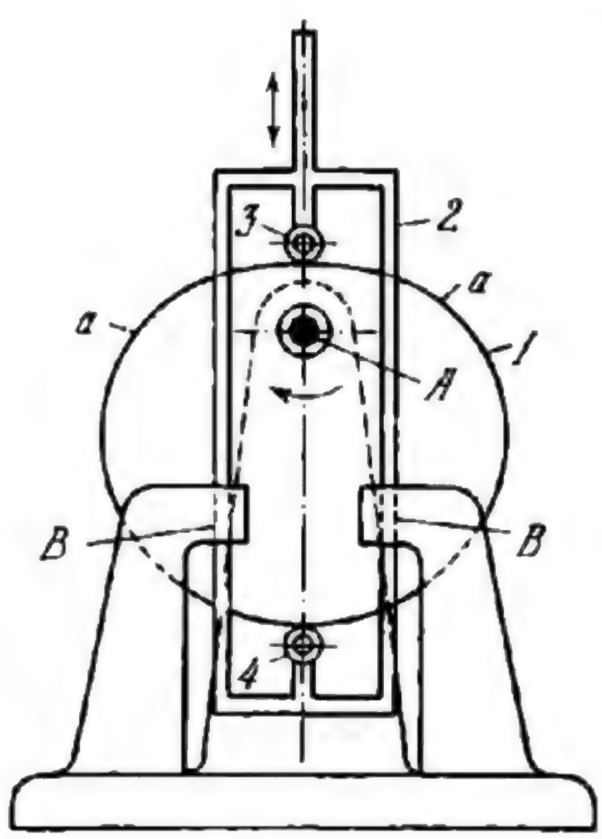
Cam *1* is rigidly attached to crank *3* which rotates about fixed axis *D*. Cam *1* has a contour composed of three circular arcs of radius *R* described from points *A*, *B*, and *C*. Follower (slide) *2* reciprocates in fixed guides *b-b* and has a yoke with the distance (breadth) *R* between flat faces *a* which confine cam *1*. Positive motion is achieved because all the diameters of cam *1* equal *R*. The stroke of slide *2* equals $2\overline{DB} + R$. Slide *2* has harmonic motion with smooth reversal at the extreme positions.

2997	THREE-LINK CONSTANT-DIAMETER CAM MECHANISM WITH CONSTANT FOLLOWER VELOCITY	SmC 3L



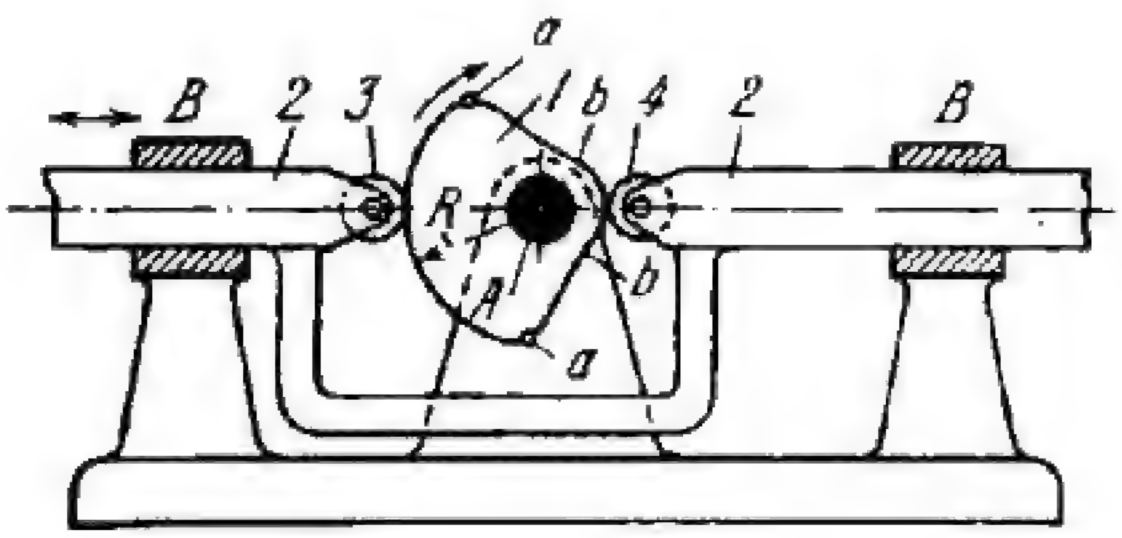
Cam *1* rotates about fixed axis *A* and its theoretical, or pitch, curve is composed of two identical spirals *a* of Archimedes. Follower *2* reciprocates in fixed guides *B-B* and carries two rollers *3* and *4* which roll along the working curve (profile) of cam *1*. When cam *1* rotates at constant speed, follower *2* travels at constant velocity with instantaneous dwells at the extreme positions. Positive motion is achieved because the sums of all opposing radius vectors of theoretical curves *a* are equal to the distance between the centres of rollers *3* and *4*.

2998	THREE-LINK CONSTANT-DIAMETER CAM MECHANISM WITH CONSTANT FOLLOWER ACCELERATION	SmC 3L



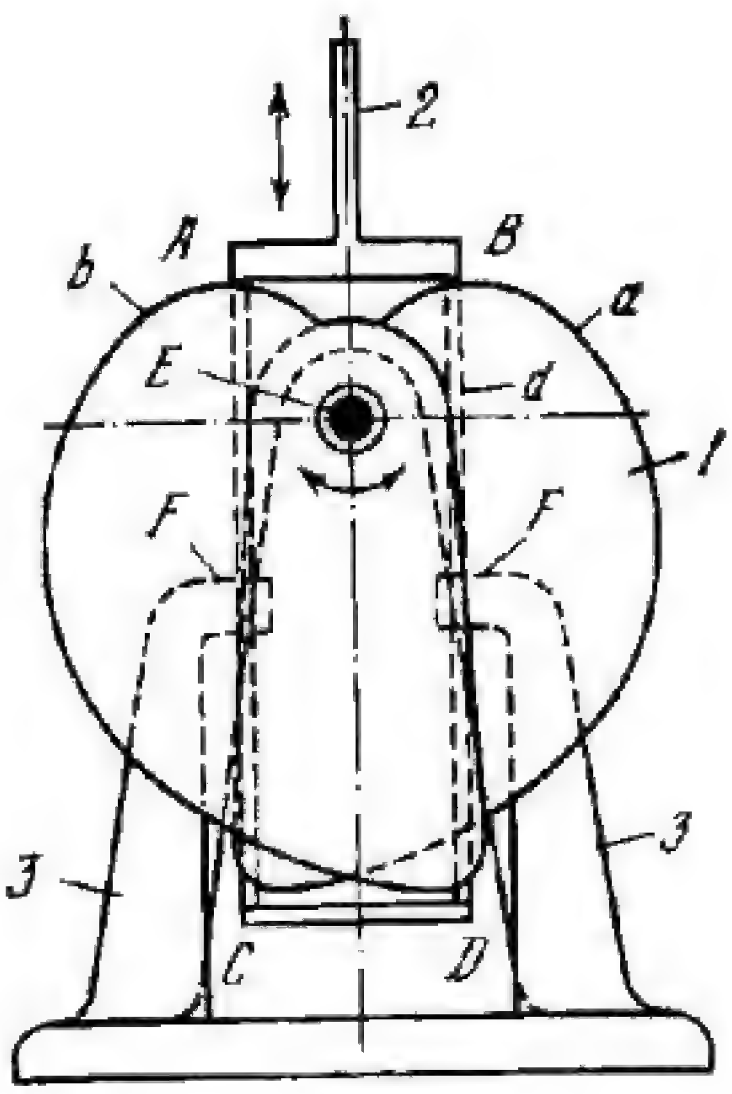
Cam *1* rotates about fixed axis *A* and its theoretical, or pitch, curve is composed of two identical curves *a* that are designed to satisfy the condition of constant acceleration and deceleration of follower *2*. Follower *2* reciprocates in fixed guides *B-B* and carries two rollers *3* and *4* which roll along the working curve *a* of cam *1*. When cam *1* rotates at constant speed, follower *2* travels at constant acceleration and deceleration in its rise and return. Positive motion is achieved because the sums of all opposing radius vectors of the theoretical curves are equal to the distance between the centres of rollers *3* and *4*.

2999 THREE-LINK CONSTANT-DIAMETER CAM MECHANISM WITH LONG DWELLS AT THE TWO EXTREME POSITIONS — SmC 3L



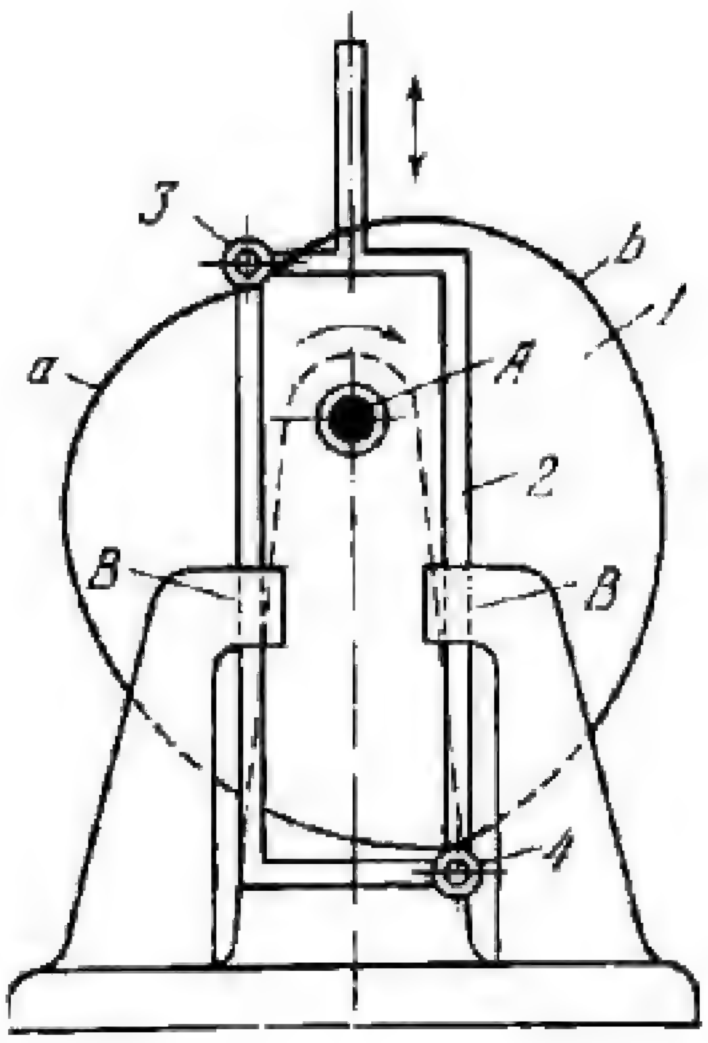
Cam *1* rotates about fixed axis *A* and has a contour of which portions *a-a* and *b-b* are concentric circular arcs of radii *R* and *r*. Follower *2* reciprocates in fixed guides *B-B* and carries two rollers, *3* and *4*, which roll along the working curve (profile) of cam *1*. When cam *1* rotates continuously, follower *2* has long dwells at the extreme positions where rollers *3* and *4* contact portions *a-a* and *b-b* of the cam. Positive motion is achieved because the sums of all opposing radius vectors of the theoretical curve of cam *1* are equal to the distance between the centres of rollers *3* and *4*.

3000 THREE-LINK DOUBLE SPIRAL CAM MECHANISM — SmC 3L



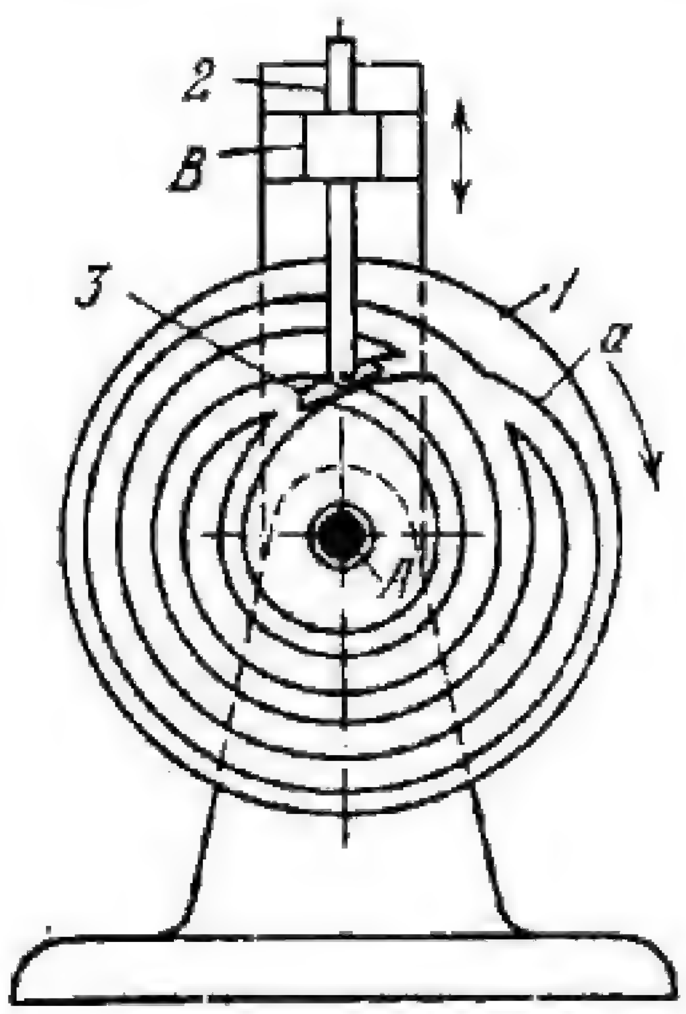
Cam *1* rotates about fixed axis *E* and has two symmetrical spiral contours *a* and *b*, arranged one behind the other. Follower *2* is designed as yoke *d* and reciprocates in fixed guides *F-F*. Yoke *d* has four lugs *A*, *B*, *C* and *D*. Contour *a* slides over lugs *B* and *C*; contour *b* over lugs *A* and *D*. Contours *a* and *b* contact the lugs consecutively, thereby providing for positive motion. The spiral profiles are designed to obtain follower travel at uniform velocity.

3001	THREE-LINK OFFSET CONSTANT-DIAMETER CAM MECHANISM	SmC 3L



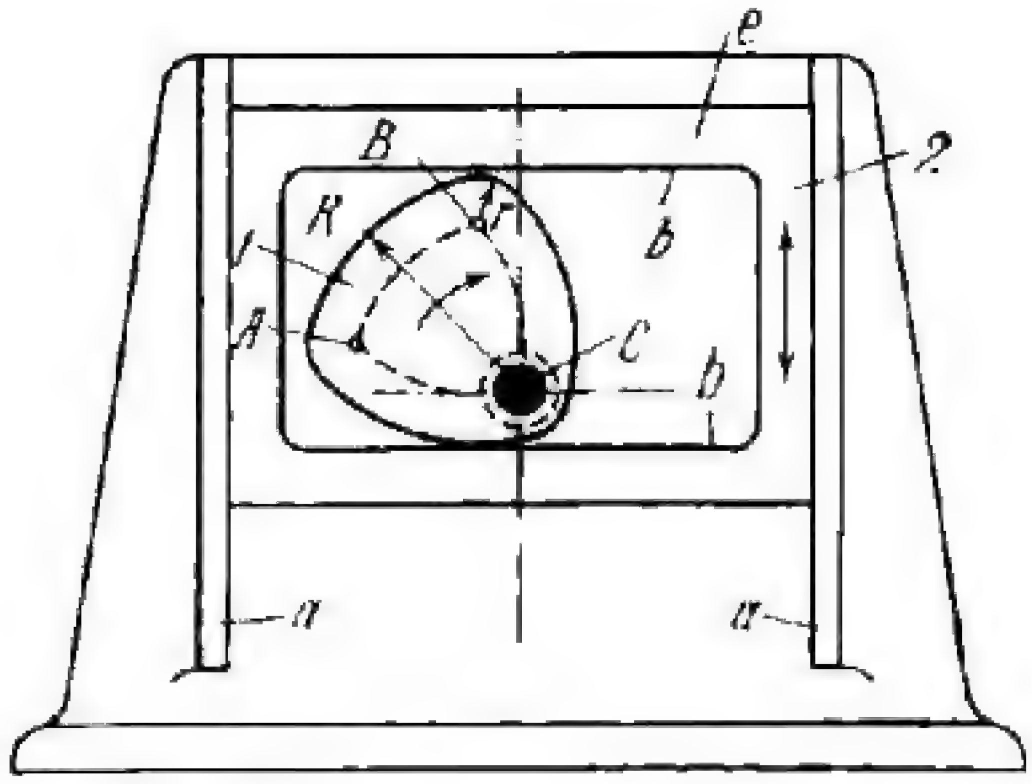
Cam *1* rotates about fixed axis *A*. Follower *2* reciprocates in fixed guides *B-B* and carries two rollers, *3* and *4*, which roll along the working curve of cam *1*, composed of two different portions *a* and *b*. The contour of cam *1* is designed so that follower *2* has reciprocating motion at constant velocity when cam *1* rotates at constant angular velocity. Positive motion is achieved because the theoretical curve of the cam is designed so that there is a constant distance, equal to the distance between the centres of rollers *3* and *4*, between two points of this curve lying on a straight line which passes through these centres for any position of the cam.

3002	THREE-LINK DOUBLE CROSS-GROOVED FACE CAM MECHANISM	SmC 3L



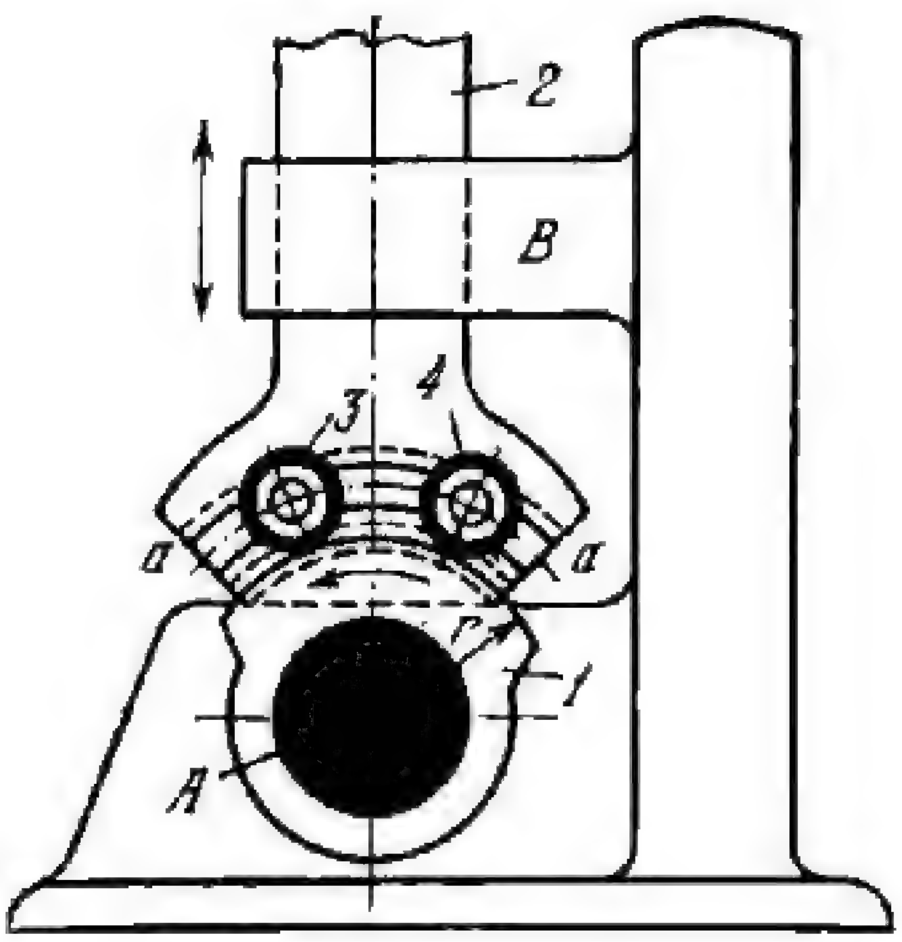
Cam *1* rotates about fixed axis *A* and has doubly self-intersecting cam groove *a*. Follower *2* reciprocates in fixed guide *B* and carries pivoted lens-shaped member *3* which slides along groove *a*. In one cycle of motion, equal to three revolutions of cam *1*, the follower has three rises with different types of motion and three returns with different types of motion. Follower *2* has dwells while member *3* slides along circular concentric portions of groove *a*.

3003	THREE-LINK THREE-LOBE CONSTANT-BREADTH CAM MECHANISM	SmC 3L



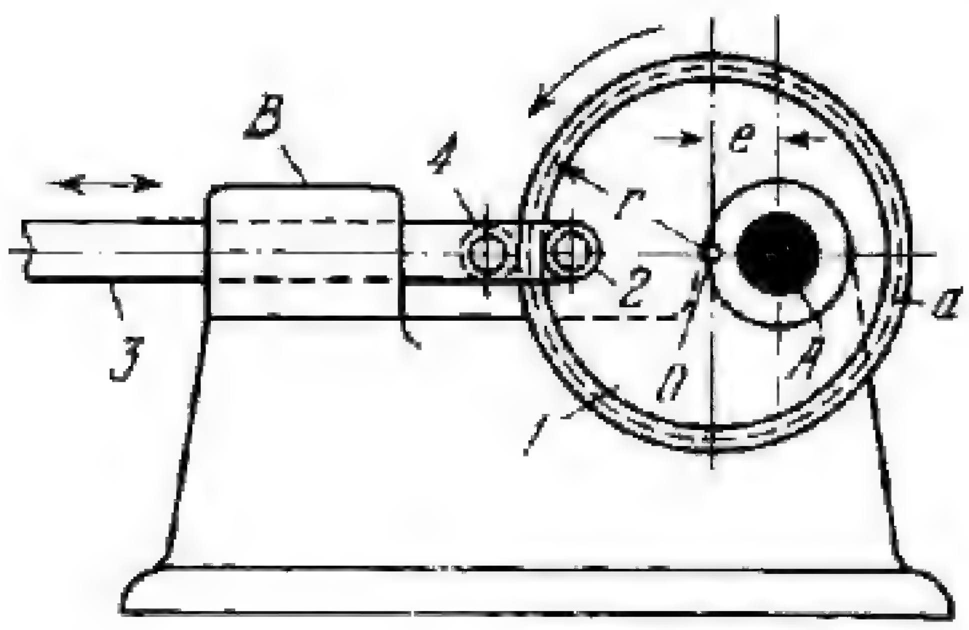
Cam *1* rotates about fixed axis *C* and has a contour composed of circular arcs of radii *R* and *r*, described from points *A*, *B* and *C*. These points are the vertexes of a triangular figure consisting of three arcs $CA = AB = BC$ of radius $R - r$. Follower *2* reciprocates in fixed guides *a-a* and has yoke *e* consisting of two flat faces *b* with the distance $R + r$ between them. Follower *2* has long dwells at its extreme positions. Positive motion is achieved because cam *1* is of constant diameter $(R + r)$ equal to the distance between faces *b* (breadth) of yoke *e*.

3004	THREE-LINK VARIABLE-DWELL CAM MECHANISM	SmC 3L



Cam *1* rotates about fixed axis *A* and has a contour with a lobe along a concentric circular arc of radius *r*. Follower *2* reciprocates in fixed guide *B* and carries rollers *3* and *4* which can be adjusted along and clamped in various positions in concentric circular guide *a-a*. Periods of motion and rest of follower *2* are varied by changing the positions of rollers *3* and *4*. To increase the dwell at the upper position of the follower, the distance between the rollers should be increased. The instant dwell begins with reference to cam *1* is varied by adjusting roller *4* along guide *a-a*.

3005	THREE-LINK ROUND ECCENTRIC RIDGE CAM MECHANISM	SmC 3L

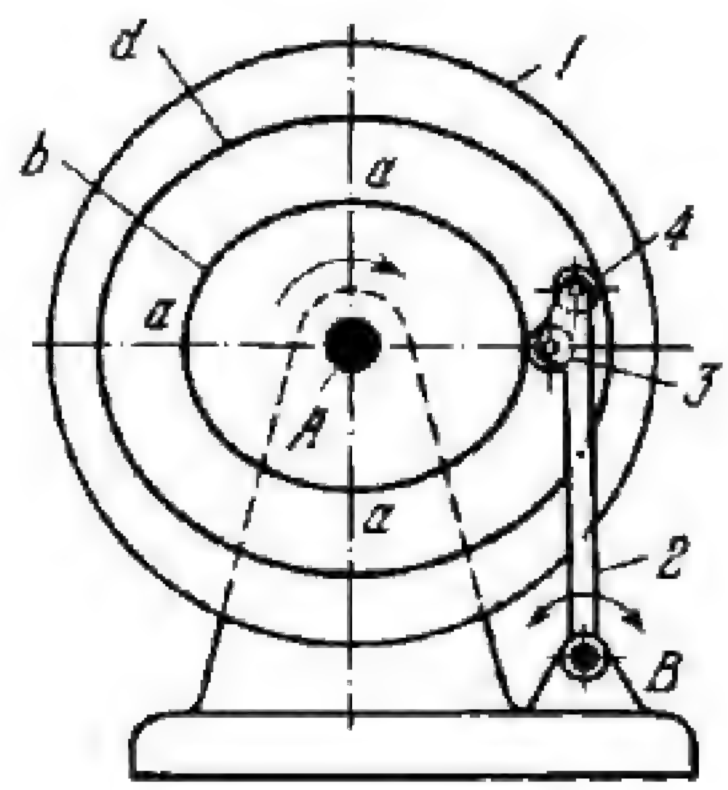


Cam *1* rotates about fixed axis *A* and its profile is designed as an eccentrically mounted circular member with ridge *a*. Follower *3* reciprocates in fixed guide *B* and carries rollers *2* and *4* which roll along the inner and outer surfaces of ridge *a*. The displacement of follower *3* from its extreme right-hand position is

$$s_3 = e\,(1 + \cos\varphi) - r\left[1 - \sqrt{1 - \left(\frac{e}{r}\right)^2 \sin^2\varphi}\,\right]$$

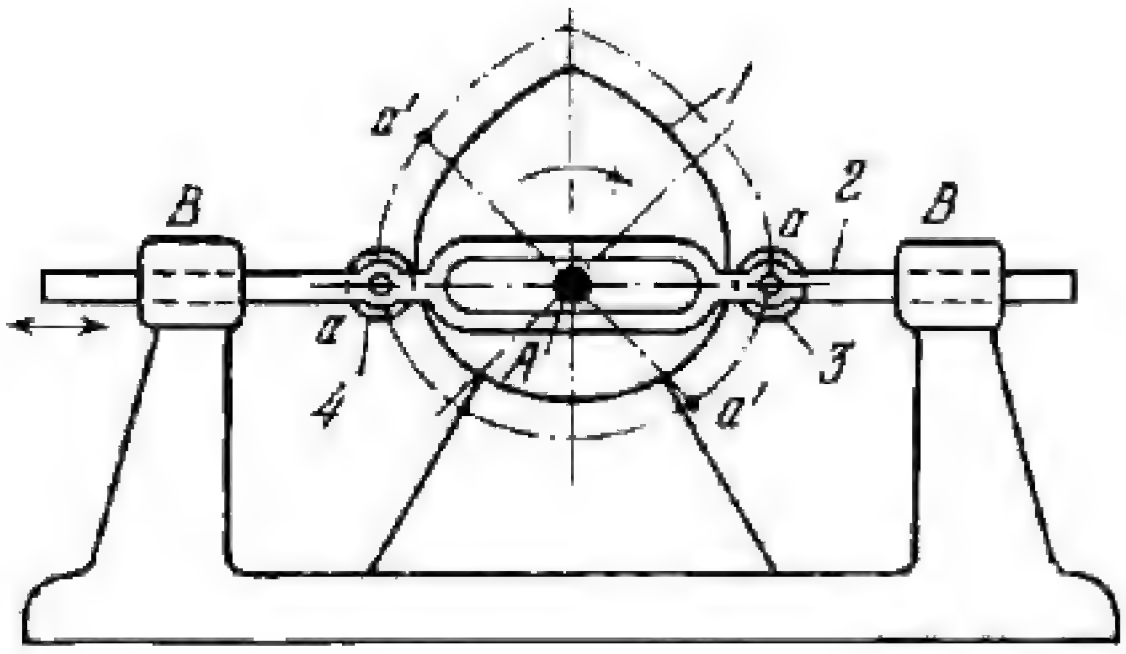
where $e = \overline{OA}$ is the eccentricity of cam *1*, r is the radius of the theoretical, or pitch, curve of the cam and φ is its angle of rotation.

3006	THREE-LINK DOUBLE-ROLLER OSCILLATING-FOLLOWER FACE CAM MECHANISM	SmC 3L



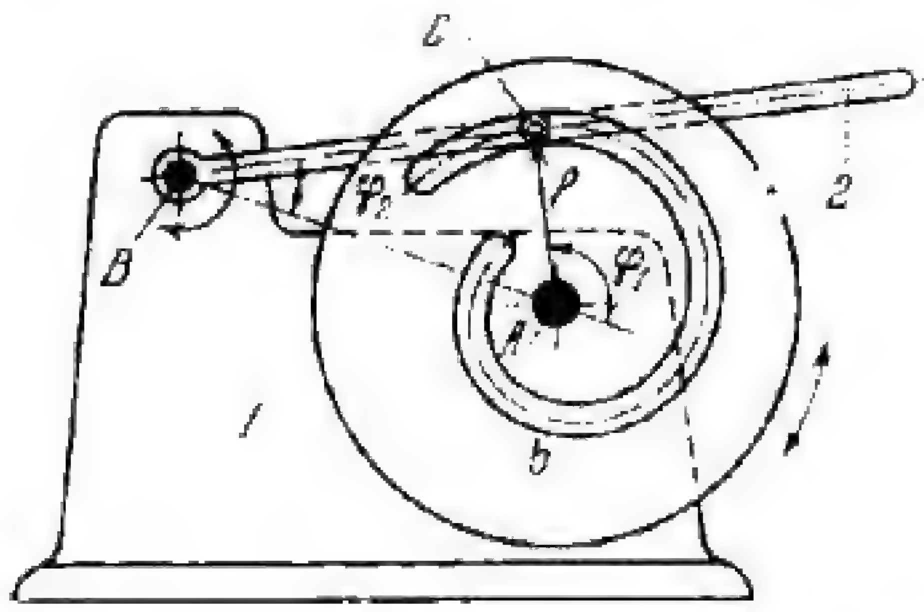
Cam *1* rotates about fixed axis *A* and has groove *a* with side surfaces *b* and *d* of different profiles. Follower *2* oscillates about fixed axis *B* and carries two nonsymmetrically located rollers *3* and *4*. Positive motion is achieved because roller *3* rolls along side surface *b* of groove *a* and roller *4* along side surface *d*. The profiles of surfaces *b* and *d* are the envelopes of the positions of rollers *3* and *4* in the motion of follower *2* with respect to cam *1*.

3007	**THREE-LINK CONSTANT-DIAMETER SPIRAL CAM MECHANISM**	SmC 3L



Cam *1* rotates about fixed axis *A* and its contour is composed of two symmetrical portions of spirals of Archimedes. Follower *2* reciprocates in fixed guides *B*-*B* and carries two rollers *3* and *4*. Positive motion is achieved because all the diameters of the theoretical, or pitch, curve of cam *1* are equal, i.e. $\overline{aa} = \overline{a'a'} = \ldots$ $\ldots = \text{const}$, and equal to the distance between the centres of rollers *3* and *4*.

3008	**THREE-LINK SPIRAL FACE CAM MECHANISM**	SmC 3L



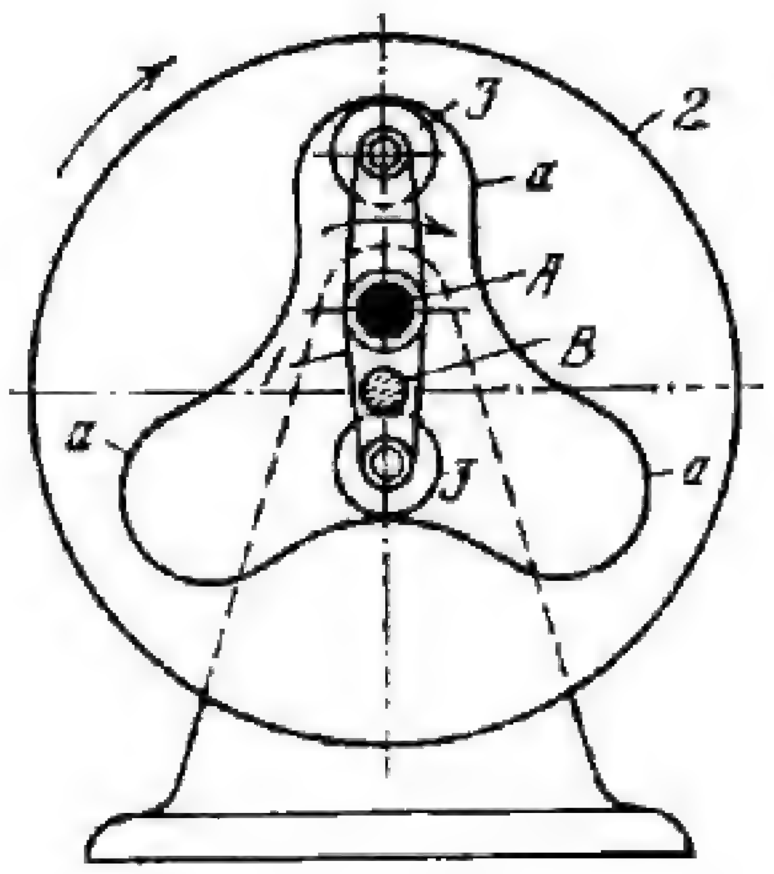
Cam *1* oscillates about fixed axis *A* and has groove *b* whose theoretical, or pitch, curve is along a spiral of Archimedes. Follower *2* oscillates about fixed axis *B* and carries pin *C* which slides along groove *b*. The angle of rotation of follower *2* is

$$\varphi_2 = \arctan \frac{a\varphi_1 \sin\varphi_1}{\overline{BA} + a\varphi_1 \cos\varphi_1}$$

where φ_1 is the angle of cam rotation, $\overline{BA}$ is the distance between axes *A* and *B*, and *a* is the constant parameter of the Archimedian spiral. The position of point *C* on the follower is found by the equation

$$\overline{BC} = a\varphi_1 \frac{\sin\varphi_1}{\sin\varphi_2}.$$

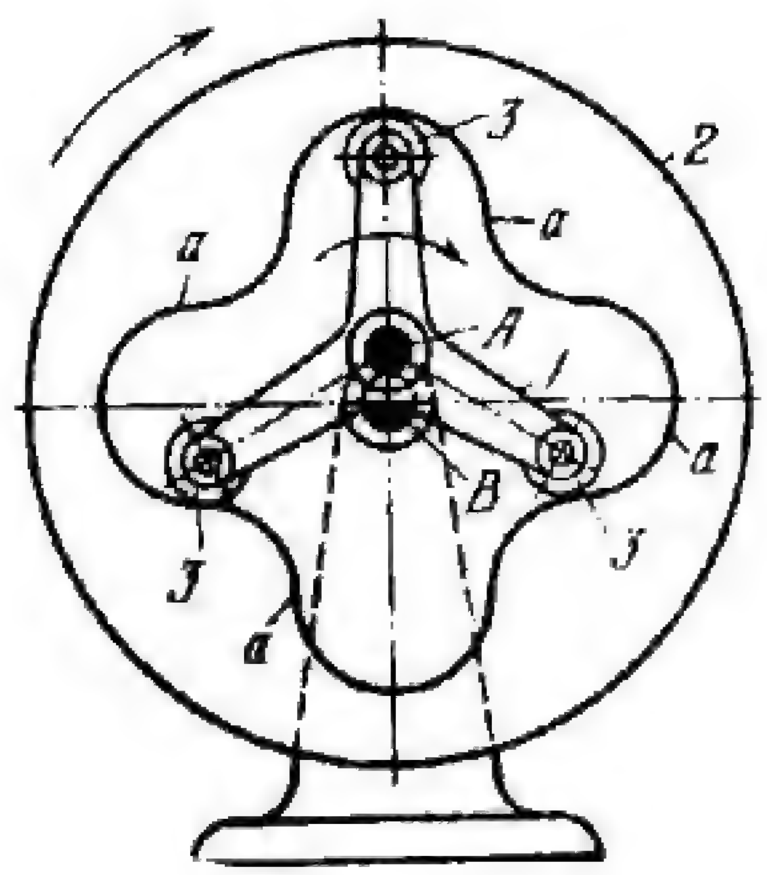
3009	THREE-LINK DOUBLE-CRANK INVERSE CAM MECHANISM	SmC 3L



Double crank *1* rotates about fixed axis *A* and carries two rollers *3*. Cam disk *2* rotates about fixed axis *B* and has internal contour *a* composed of three symmetrically arranged portions. When crank *1* rotates, rollers *3* roll along contour *a*, rotating disk *2* in the same direction. Continuous rotation of disk *2* is due to the provision of two rollers *3*. The speeds n_1 and n_2 of crank *1* and disk *2* (in rpm) are related by the equation

$$n_2 = \frac{2}{3} n_1.$$

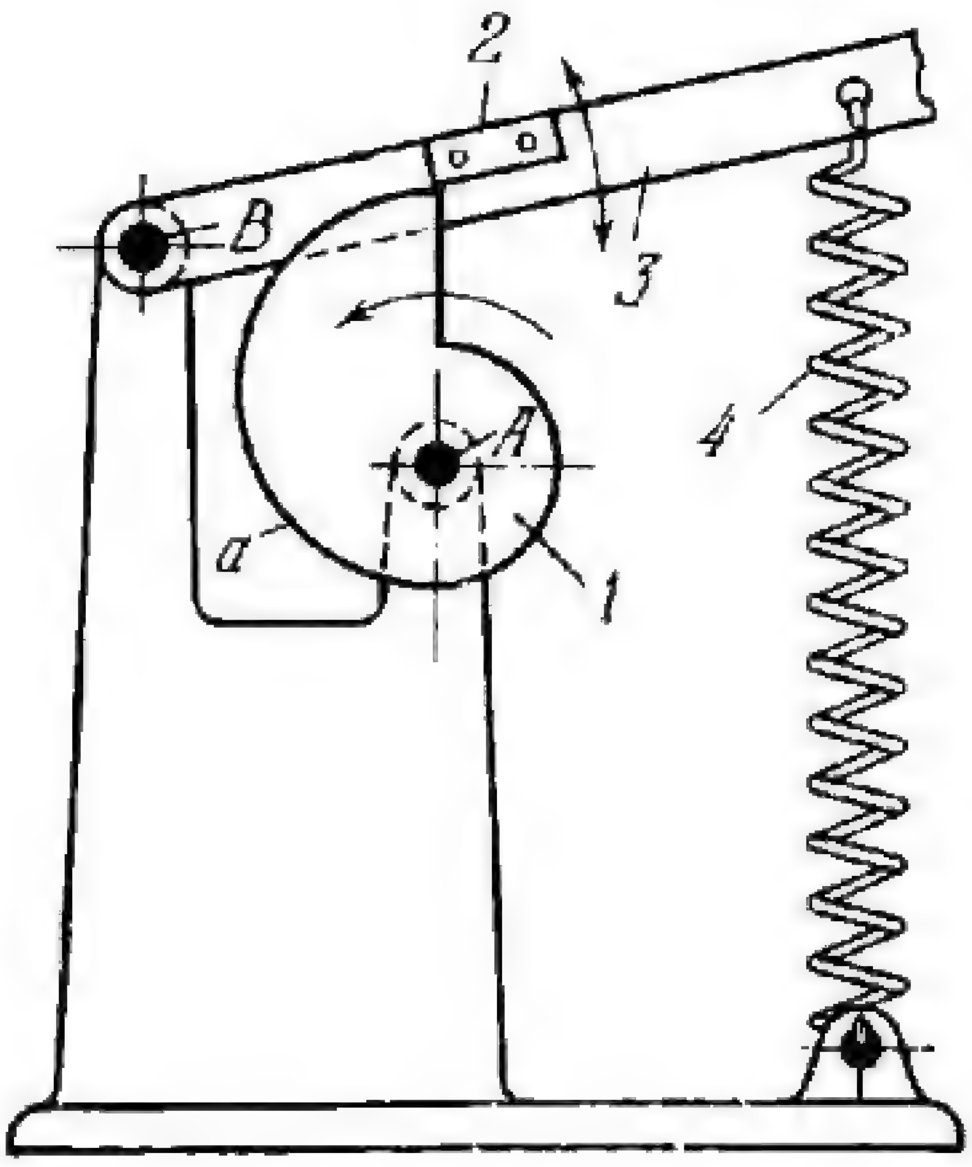
3010	THREE-LINK TRIPLE-CRANK INVERSE CAM MECHANISM	SmC 3L



Triple crank *1* rotates about fixed axis *A* and carries three symmetrically located rollers *3*. Cam disk *2* rotates about fixed axis *B* and has internal contour *a* composed of four symmetrically arranged portions. When crank *1* rotates, rollers *3* roll along contour *a*, rotating disk *2* in the same direction. Continuous rotation of disk *2* is due to the provision of three rollers *3*. The speeds n_1 and n_2 of crank *1* and disk *2* (in rpm) are related by the equation

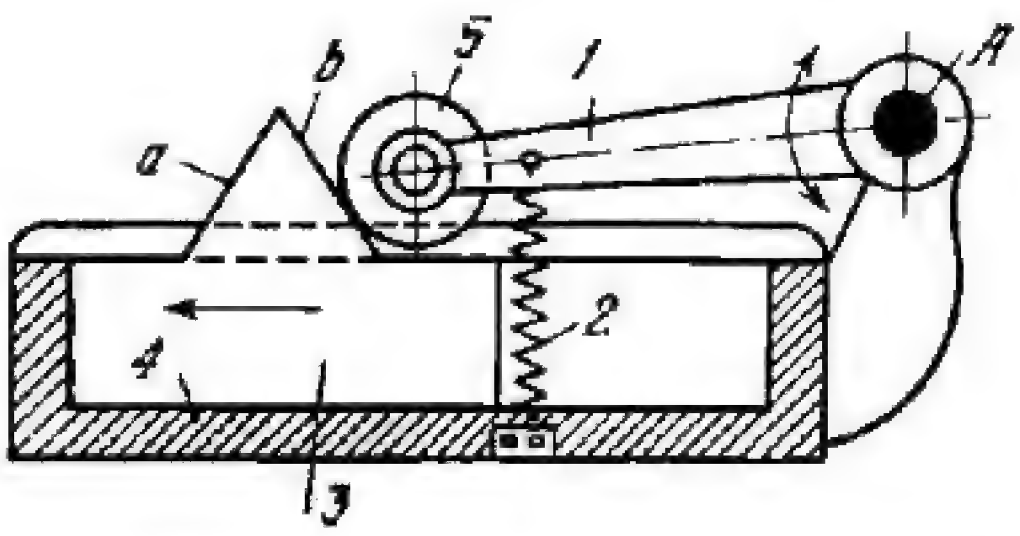
$$n_2 = \frac{3}{4} n_1.$$

3011	THREE-LINK IMPACTING OSCILLATING-FOLLOWER CAM MECHANISM	SmC 3L



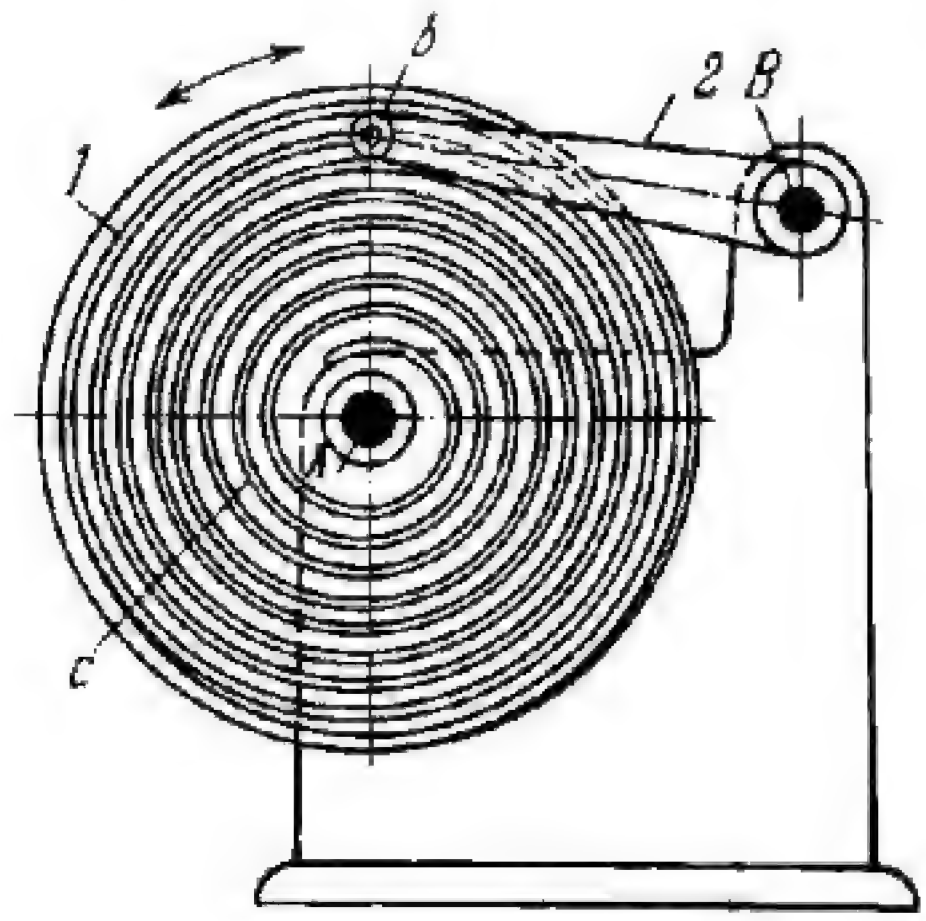
Cam *1* rotates about fixed axis *A* and its contour *a* is along an involute of a circle. Follower *3* oscillates about fixed axis *B* and carries strip *2* which slides along contour *a*. After cam *1* rotates 360°, strip *2* slides off contour *a* and spring *4* returns follower *3* with an impact to its initial position.

3012	THREE-LINK INDEXED-FOLLOWER CAM MECHANISM	SmC 3L



Follower *1* turns about fixed axis *A* and carries roller *5*. Cam *3* slides along fixed guide *4* and its contour consists of two flat surfaces *a* and *b*. When cam *3* travels from its extreme right-hand position, roller *5* first rolls along surface *a*, turning follower *1* clockwise. Then it rolls along surface *b* and follower *1* turns counterclockwise. Roller *5* indexes cam *3* in its extreme positions. Roller *5* is held in contact with cam *3* by spring *2*.

3013	THREE-LINK MULTIPLE-TURN SPIRAL FACE CAM MECHANISM	SmC 3L

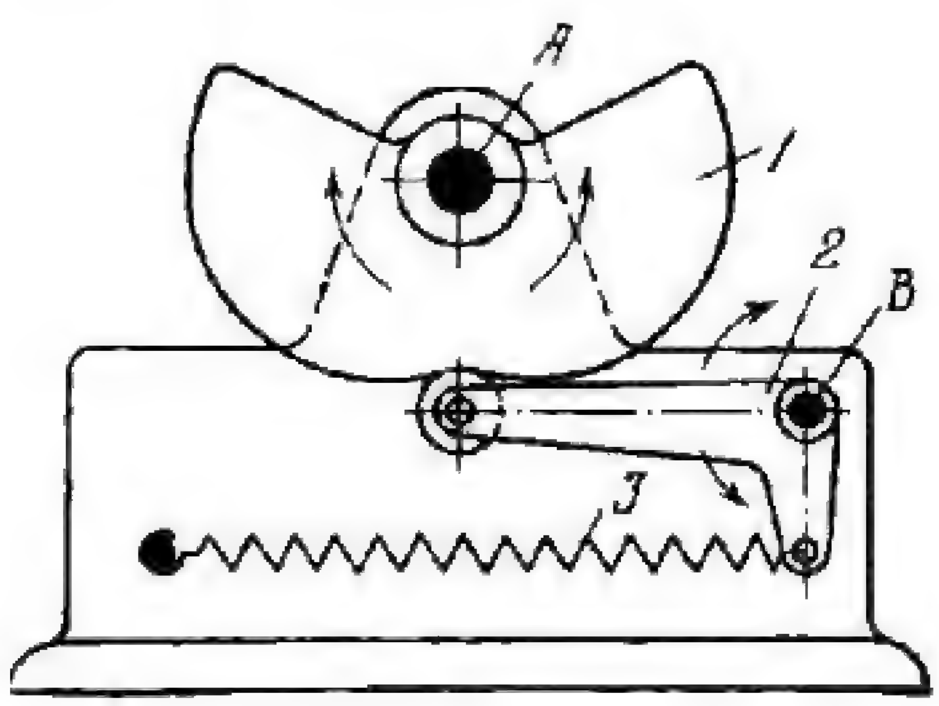


Cam *1* rotates about fixed axis *A* and has groove *c* profiled along an Archimedian spiral. Follower *2* turns about fixed axis *B* and carries roller *b* which slides and rolls along groove *c*. The polar equation of the theoretical, or pitch, curve of the spiral groove is

$$\rho = a\varphi$$

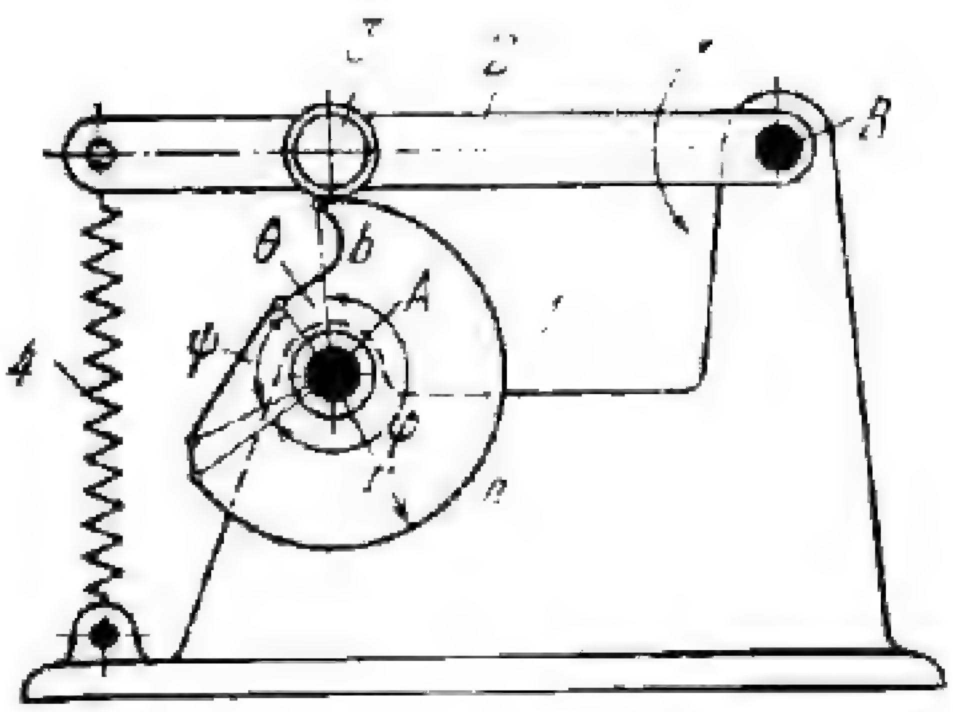
where *a* is a small value. Consequently, the groove has about ten turns, and a cycle of rise and return of follower *2* corresponds to about twenty revolutions of cam *1*, ten in each direction.

3014	THREE-LINK SPRING-LOADED OSCILLATING-FOLLOWER CAM MECHANISM	SmC 3L



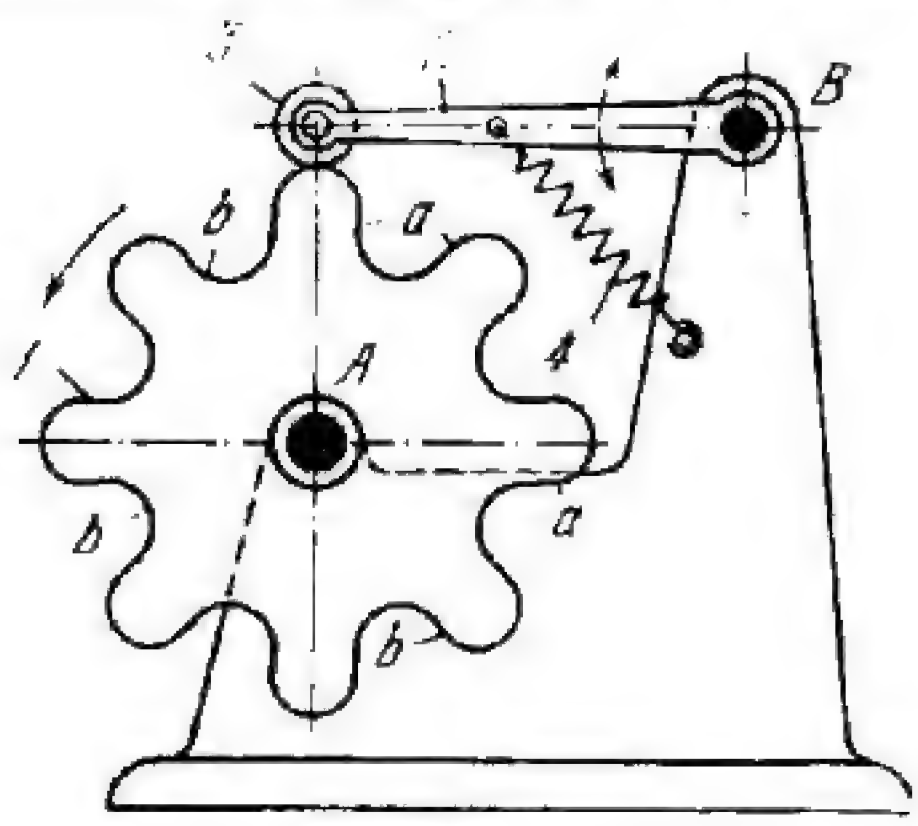
When cam *1* is turned about fixed axis *A*, it deviates follower (bell-crank lever) *2*, stretching spring *3*. When cam *1* is released, spring *3* turns follower *2* about fixed axis *B* in the opposite direction, returning cam *1* to its initial position and indexing it in this central position (as shown).

3015	THREE-LINK LOCKING-FOLLOWER CAM MECHANISM	SmC 3L



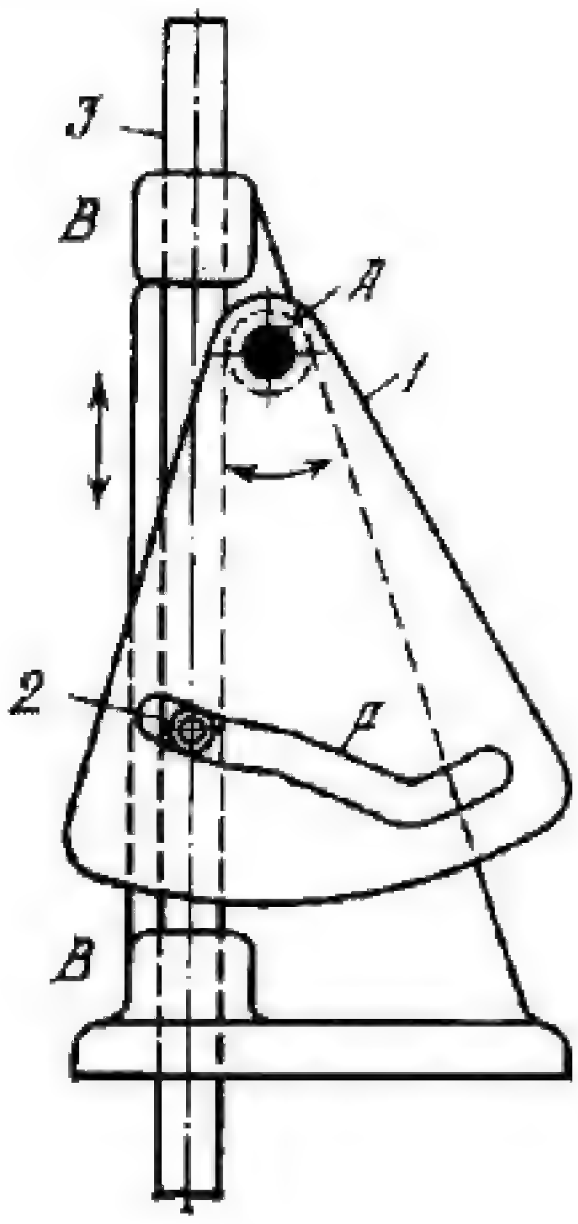
Cam *1* rotates about fixed axis *A* and its contour *a* is composed of three portions: a concentric circular arc of radius *r* within central angle φ, a straight line within central angle ψ and semicircular recess *b* within angle θ. Follower *2* turns about fixed axis *B* and carries roller *3* which rolls along contour *a* of cam *1*. When cam *1* rotates clockwise, follower *2* has a rapid drop, then a slow rise and, finally, a long dwell. When cam *1* rotates counterclockwise, follower *2* has a long dwell, then a slow fall, and finally, when roller *3* enters recess *b*, follower *2* is locked. Roller *3* is held in contact with cam *1* by spring *4*.

3016	THREE-LINK MULTIPLE-PROFILE CAM MECHANISM	SmC 3L



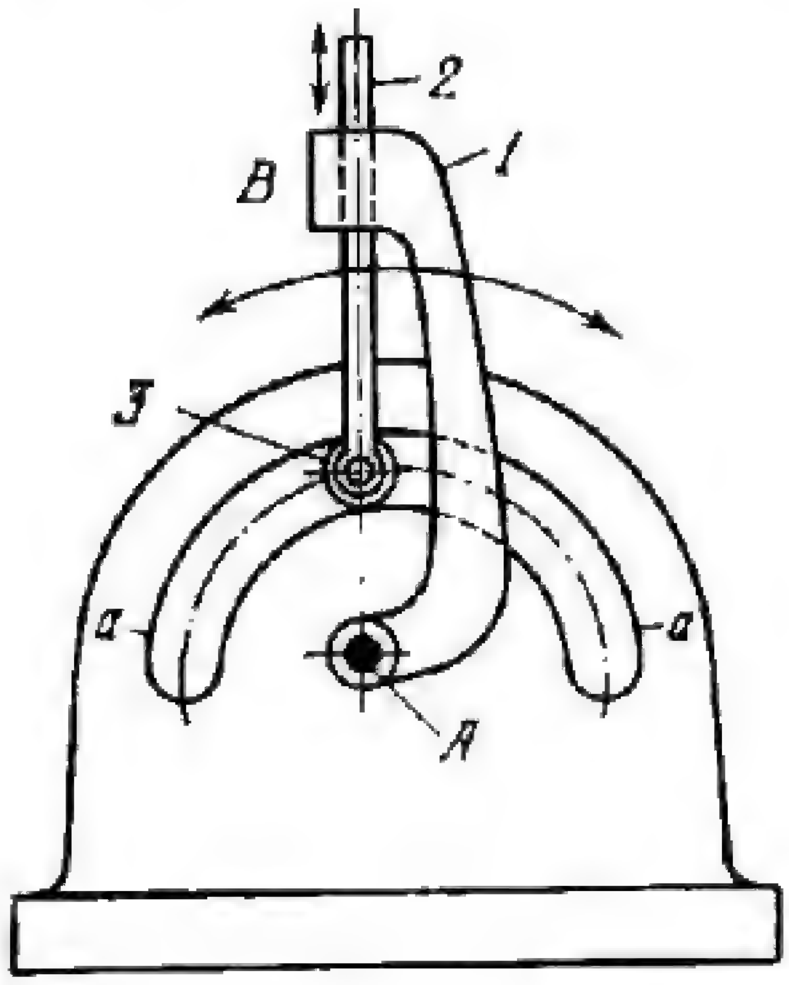
Cam *1* rotates about fixed axis *A* and its contour consists of eight profiled lobes *a* composed of tangent circular arcs. Follower *2* oscillates about fixed axis *B* and carries roller *3* which rolls along lobes *a* of cam *1*. When cam *1* rotates counterclockwise, follower *2* makes eight oscillating motions per cycle (per revolution of cam *1*) with instantaneous dwells when roller *3* contacts recesses *b*. Follower *2* locks the mechanism when cam *1* begins to rotate clockwise. Roller *3* is held in contact with cam *1* by spring *4*.

3017	THREE-LINK OSCILLATING FACE CAM MECHANISM	SmC 3L



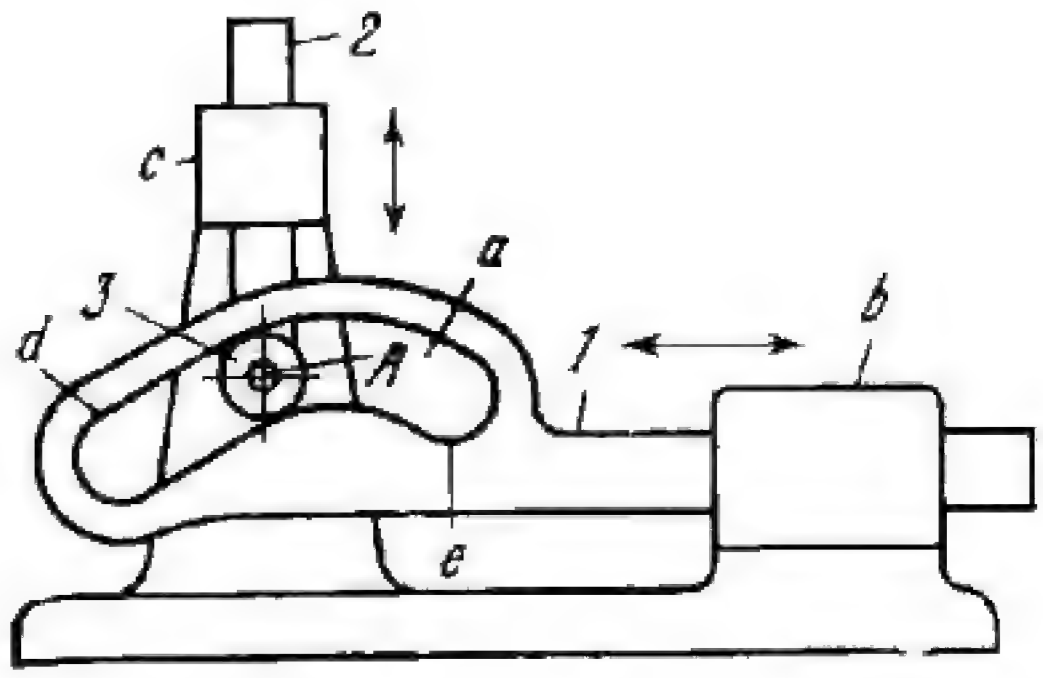
Cam *1* oscillates about fixed axis *A* and has profiled groove *a*. Follower *3* reciprocates in fixed guides *B-B* and carries roller *2* which rolls and slides along groove *a*. When cam *1* oscillates, follower *3* reciprocates. Positive motion is achieved because the diameter of roller *2* is equal to the width of groove *a*.

3018	THREE-LINK FIXED GROOVED-CAM MECHANISM	SmC 3L



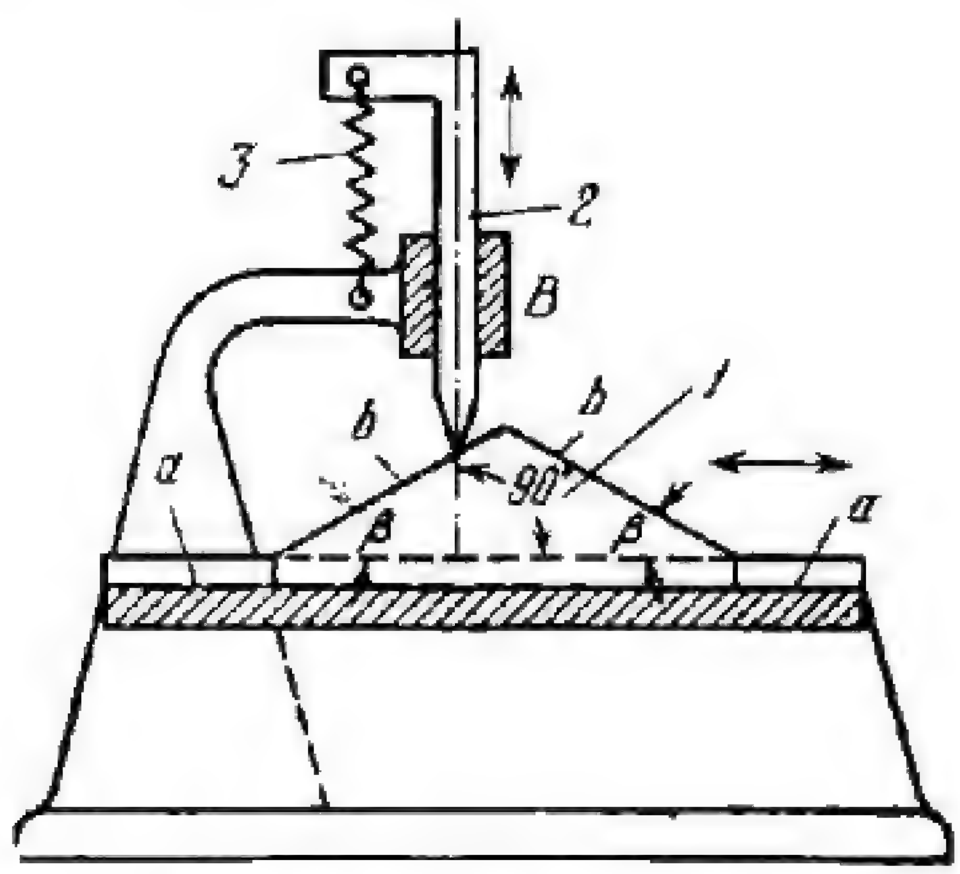
Driver *1* oscillates about fixed axis *A* and is connected by sliding pair *B* to follower *2* which carries roller *3*. Roller *3* rolls and slides along fixed profiled groove *a*. When driver *1* oscillates, follower *2* has a complex motion. Positive motion is achieved because the diameter of roller *3* is equal to the width of groove *a*.

3019	THREE-LINK SLIDING CAM MECHANISM	SmC 3L



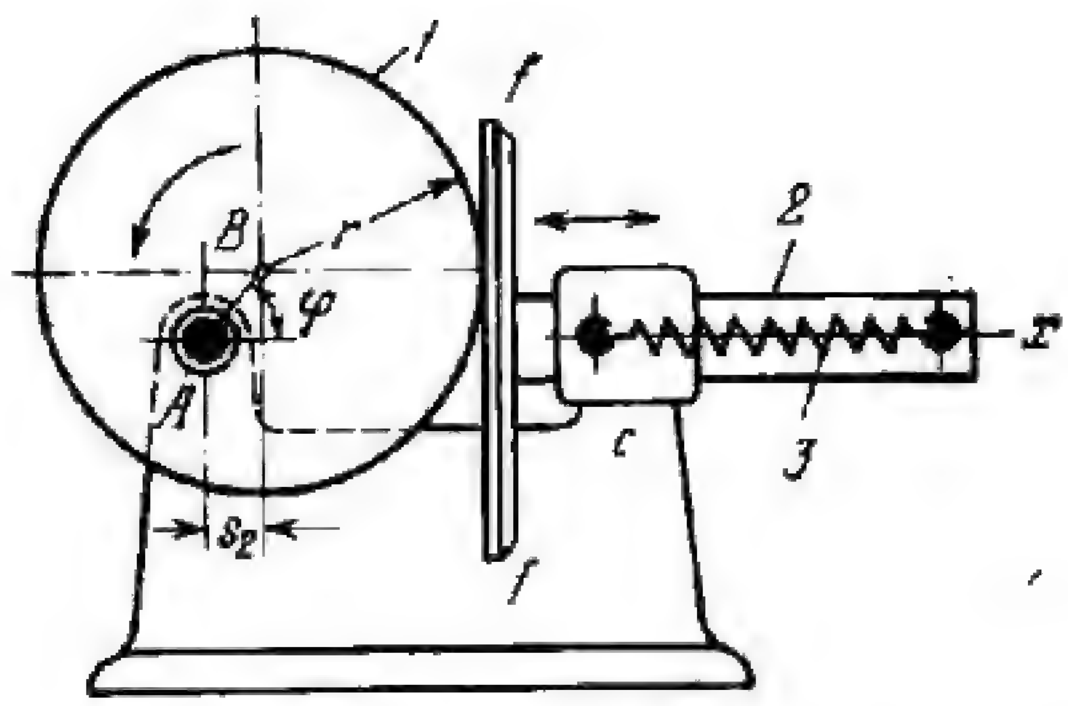
Cam *1* with profiled groove *a* reciprocates in fixed guide *b*. Follower *2* reciprocates in fixed guide *c* and carries roller *3* which rotates freely about axis *A* and rolls and slides along groove *a*. Positive motion is achieved because roller *3* is confined between side surfaces *d* and *e* of groove *a*.

3020	THREE-LINK SLIDING CAM MECHANISM WITH A SYMMETRICAL TRIANGULAR CAM	SmC 3L



Cam *1* reciprocates along fixed guides *a-a* and has symmetrical triangular contour *b*. Follower *2* reciprocates in fixed guide *B*. The displacements of cam *1* and follower *2* are related by the equation $s_2 = s_1 \tan \beta$, where β is the angle between contour *b* and the axis of guides *a-a*. The rates of rise and return of follower *2* are constant and equal. Impacts occur upon reversal of cam *1* and follower *2*. Follower *2* is held in contact with cam *1* by spring *3*.

3021	THREE-LINK ROUND ECCENTRIC CAM MECHANISM WITH A RECIPROCATING FLAT-FACED FOLLOWER	SmC 3L



Cam *1* rotates about eccentrically located fixed axis *A* and its contour is a circle of radius *r*. Follower *2* reciprocates in fixed guide *c* and has flat surface *f-f* tangent to the contour of cam *1*. When cam *1* rotates, follower *2* has harmonic motion according to the equation

$$s_2 = k \cos \varphi$$

where s_2 is the displacement of follower *2*, *k* is the distance $\overline{AB}$ (or eccentricity) of cam *1* and φ is the angle between line *AB* and axis *Ax*. The corresponding velocity and acceleration of the follower are

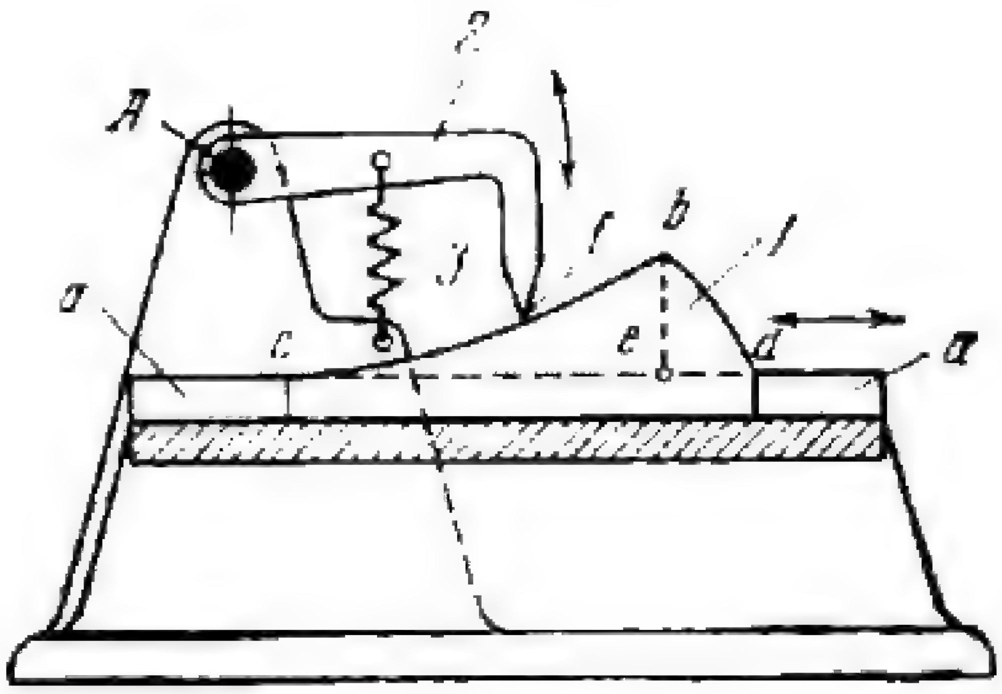
$$v_2 = -\omega_1 k \sin \varphi \text{ and } a_2 = -\omega_1^2 k \cos \varphi$$

and the full stroke of the follower is

$$S_2 = 2k$$

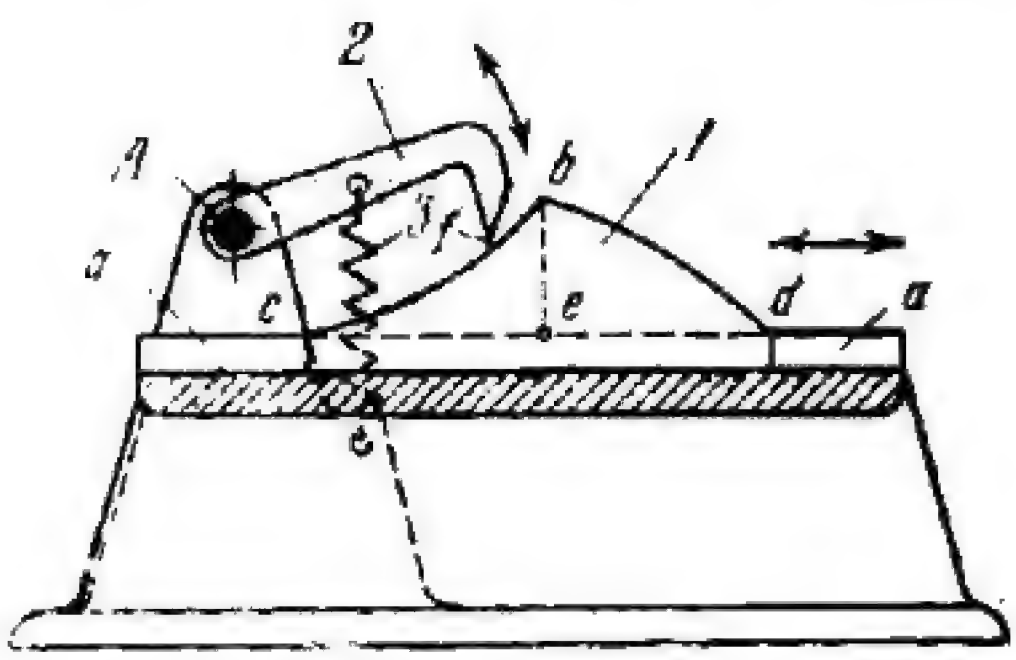
where ω_1 is the angular velocity of cam *1*, taken to be constant. Follower *2* is held in contact with cam *1* by spring *3*.

3022	THREE-LINK SLIDING CAM MECHANISM WITH UNEQUAL FOLLOWER RISE AND RETURN MOTIONS	SmC 3L



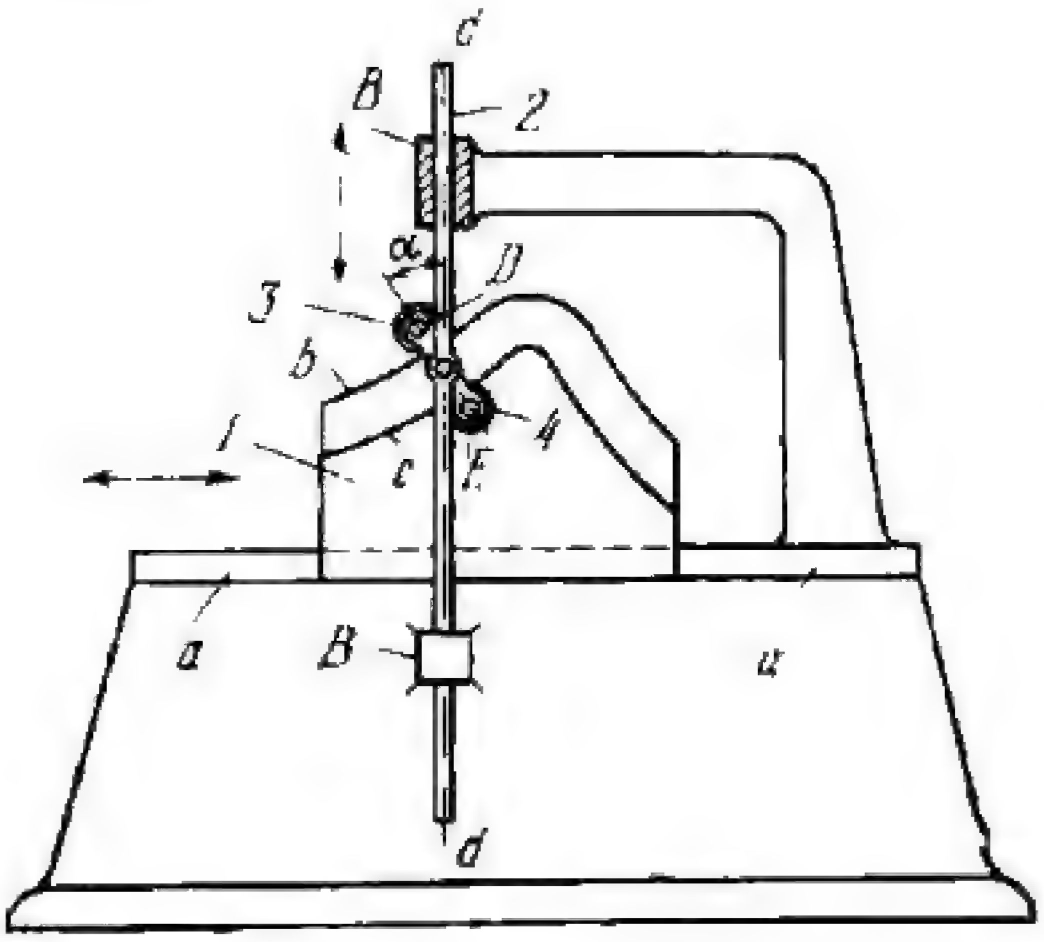
Cam *1* reciprocates along fixed guides *a-a*. Portion *cb* of its contour is along a parabola and portion *bd* is along some arbitrary convex curve. Follower *2* oscillates about fixed axis *A* and its knife-edge *f* slides along the contour of cam *1*. When knife-edge *f* slides along parabolic portion *cb*, follower acceleration is approximately constant. Owing to the different lengths *ce* and *ed* of the rise and return portions of cam *1*, the rise and return strokes in the oscillation of follower *2* are of different durations and at different velocities. Follower *2* is held in contact with cam *1* by spring *3*.

3023	THREE-LINK SLIDING CAM MECHANISM WITH EQUAL FOLLOWER RISE AND RETURN MOTIONS	SmC 3L



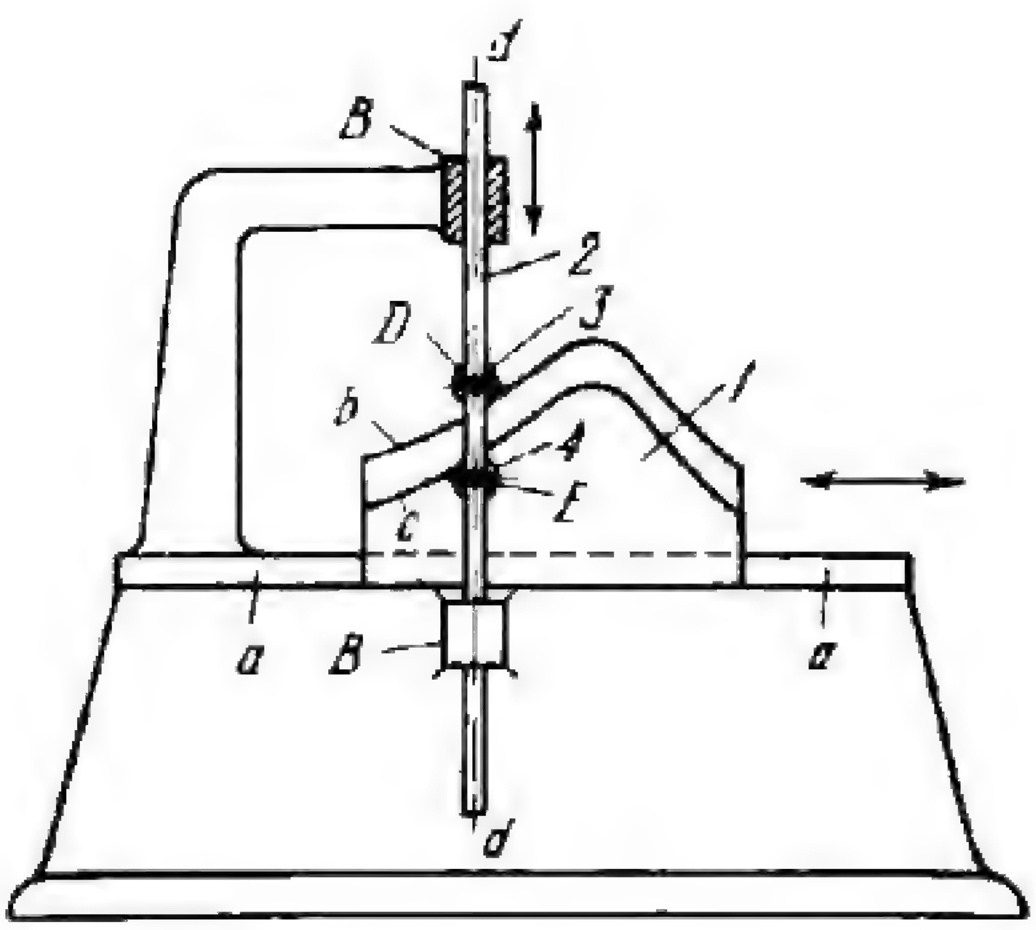
Cam *1* reciprocates along fixed guides *a-a*. Portion *cb* of its contour is along a parabola and portion *bd* is along any arbitrary convex curve. Follower *2* oscillates about fixed axis *A* and its knife-edge *f* slides along the contour of cam *1*. When knife-edge *f* slides along parabolic portion *cb*, follower acceleration is approximately constant. Owing to the equal lengths *ce* and *ed* of the rise and return portions of cam *1*, the rise and return strokes of follower *2* are of the same duration. Follower *2* is held in contact with cam *1* by spring *3*.

3024	THREE-LINK SLIDING RIDGE CAM MECHANISM	SmC 3L



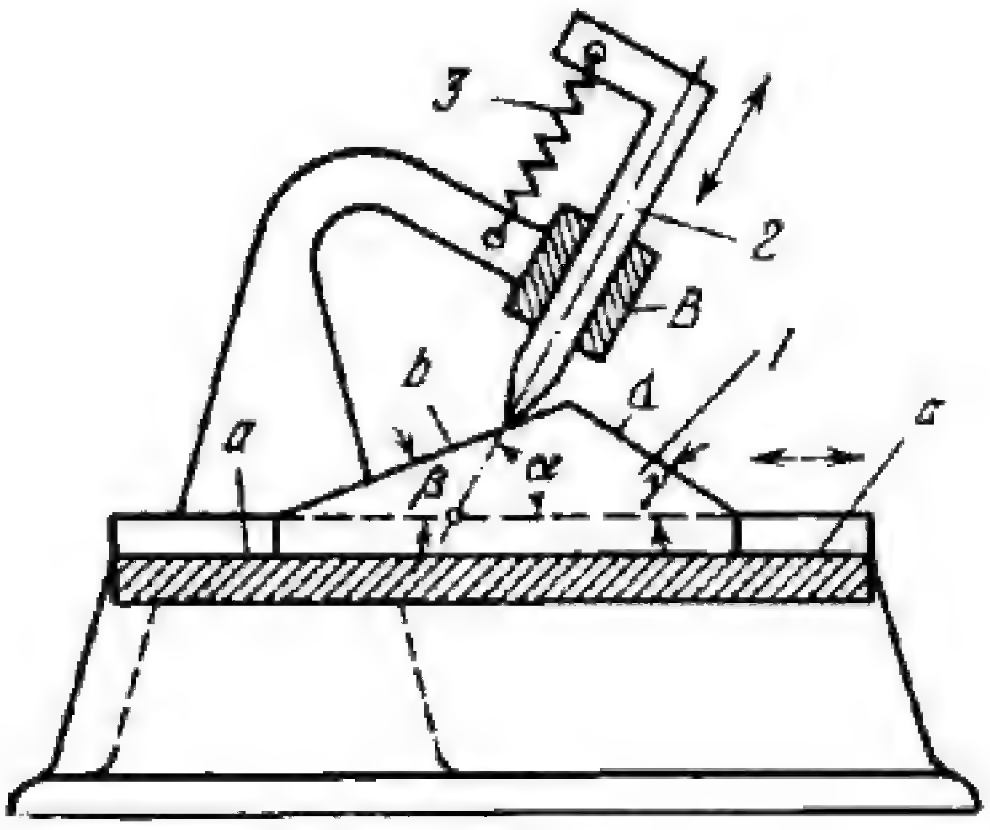
Cam *1* reciprocates along fixed guides *a-a* and has a profiled ridge. Follower *2* reciprocates in fixed guides *B-B* and carries two rollers, *3* and *4*, which roll along the side surfaces, *b* and *c*, of the ridge on cam *1*. Rollers *3* and *4* are mounted on a crosspiece which is pivoted on follower *2*. Positive motion is achieved because the distance between the theoretical, or pitch, curves of surfaces *b* and *c* is constant and equal to $\overline{DE}$, the distance between the centres of rollers *3* and *4*. Line *DE* makes the angle α with axis *d-d* of follower motion.

3025	THREE-LINK SLIDING RIDGE CAM MECHANISM	SmC 3L



Cam *1* reciprocates along fixed guides *a-a* and has a profiled ridge. Follower *2* reciprocates in fixed guides *B-B* and carries two rollers, *3* and *4*, which roll along side surfaces, *b* and *c*, of the ridge on cam *1*. The centres *D* and *E* of rollers *3* and *4* lie on axis *d-d* of follower motion. Positive motion is achieved because the distance between the theoretical, or pitch, curves of surfaces *b* and *c*, along any vertical, is constant and equal to $\overline{DE}$, the distance between the centres of rollers *3* and *4*.

3026	THREE-LINK SLIDING CAM MECHANISM WITH A TRIANGULAR CAM	SmC 3L



Cam *1* reciprocates along fixed guides *a-a* and has a triangular contour with inclined straight portions *b* and *d*. Follower *2* reciprocates in fixed guide *B*. The displacements of cam *1* and follower *2* during follower rise are related by the equation

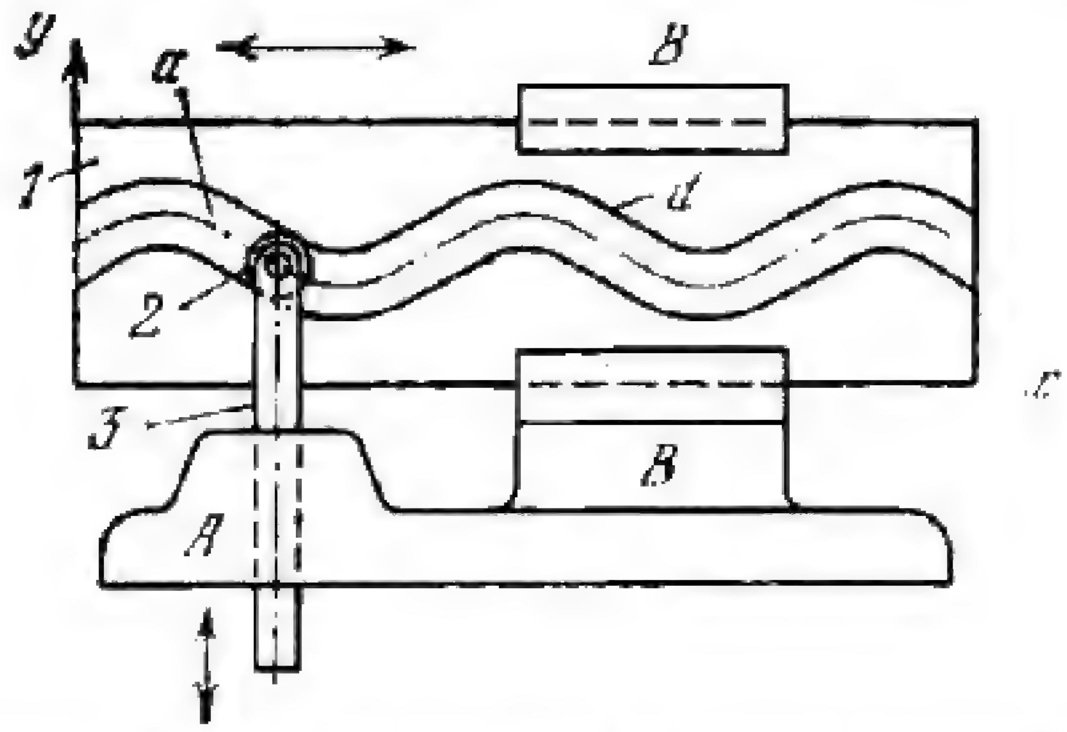
$$s_2 = s_1 \frac{\sin\beta}{\sin(\alpha - \beta)}$$

where s_1 and s_2 are the displacements of cam *1* and follower *2*, β is the angle between portion *b* of the cam contour and the axis of guides *a-a*, and α is the angle between the axis of follower motion and the axis of guides *a-a*. The corresponding equation for follower return is

$$s_2 = s_1 \frac{\sin\gamma}{\sin(\alpha + \gamma)}$$

where γ is the angle between portion *d* of the cam contour and the axis of guides *a-a*. The rise and return velocities of follower *2* are constant but different. An impact occurs upon follower reversal. Follower *2* is held in contact with cam *1* by spring *3*.

3027	THREE-LINK SLIDING CAM MECHANISM	SmC 3L

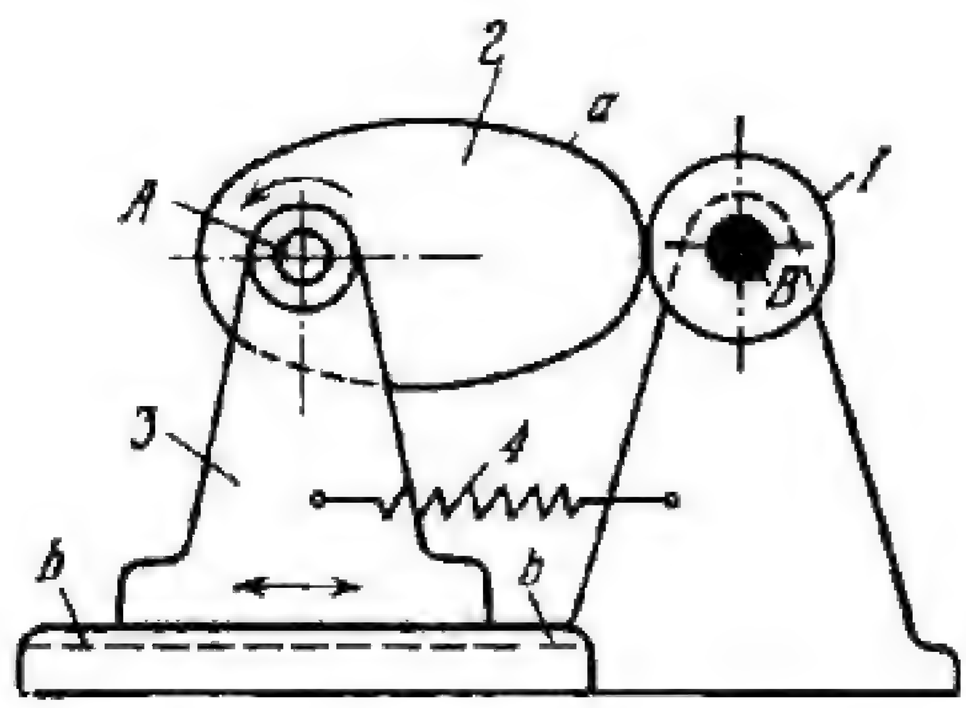


Cam 1 reciprocates in fixed guides B-B and has profiled groove *d*. Follower 3 reciprocates in fixed guide A and carries roller 2 which rolls and slides along groove *d*. The theoretical, or pitch, curve *a* of groove *d* is a sine curve. Thus, in translational motion of cam 1, follower 2 reciprocates according to the equation

$$y = C \sin x$$

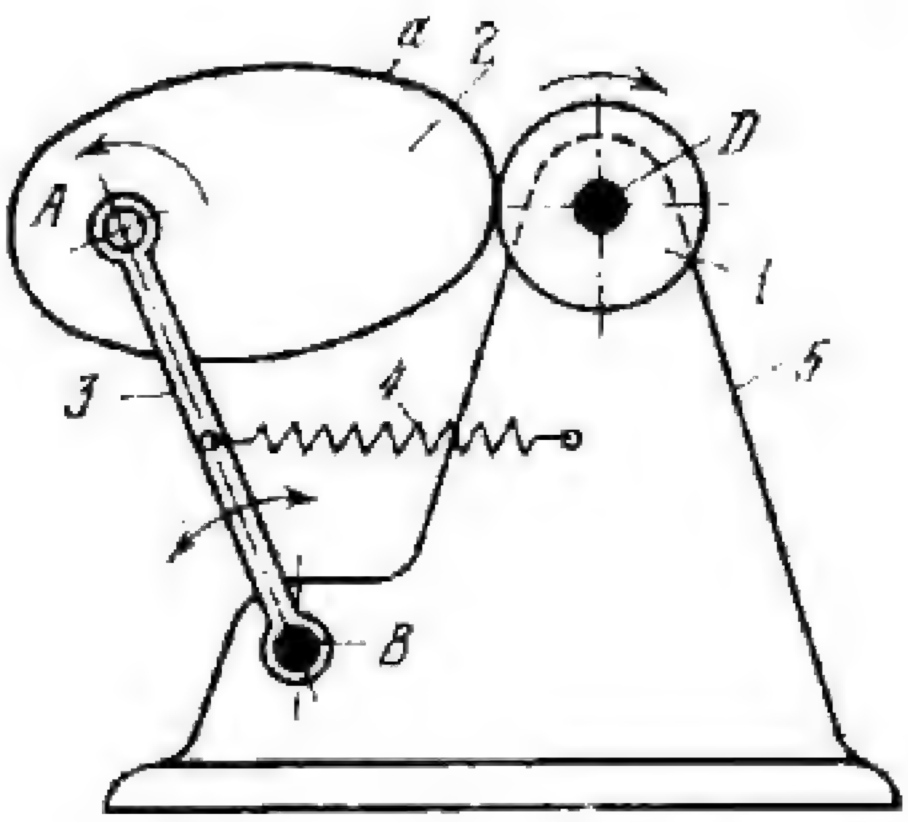
where C is the total amplitude of the sine curve. Positive motion is achieved because the diameter of roller 2 equals the width of groove *d*.

3028	ARTOBOLEVSKY THREE-LINK INVERSE CAM MECHANISM WITH COMPLEX CAM MOTION	SmC 3L



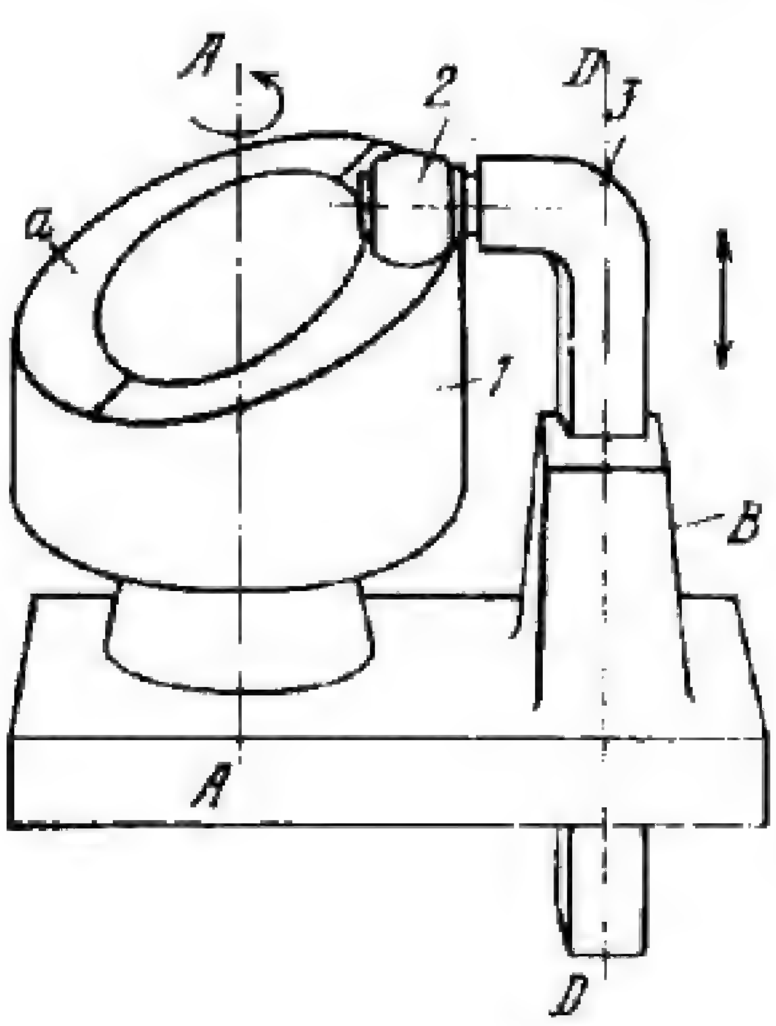
Round roller 1 rotates freely about fixed axis B. Cam 2 has contour *a* which rolls along roller 1. Cam 2 is connected by turning pair A to slider 3 which reciprocates along fixed guides *b-b*. When cam 2 rotates about axis A, it has a complex motion, reciprocating slider 3 along guides *b-b*. Cam 2 is held in contact with roller 1 by spring 4.

3029	ARTOBOLEVSKY THREE-LINK INVERSE CAM MECHANISM WITH COMPLEX CAM MOTION	SmC 3L



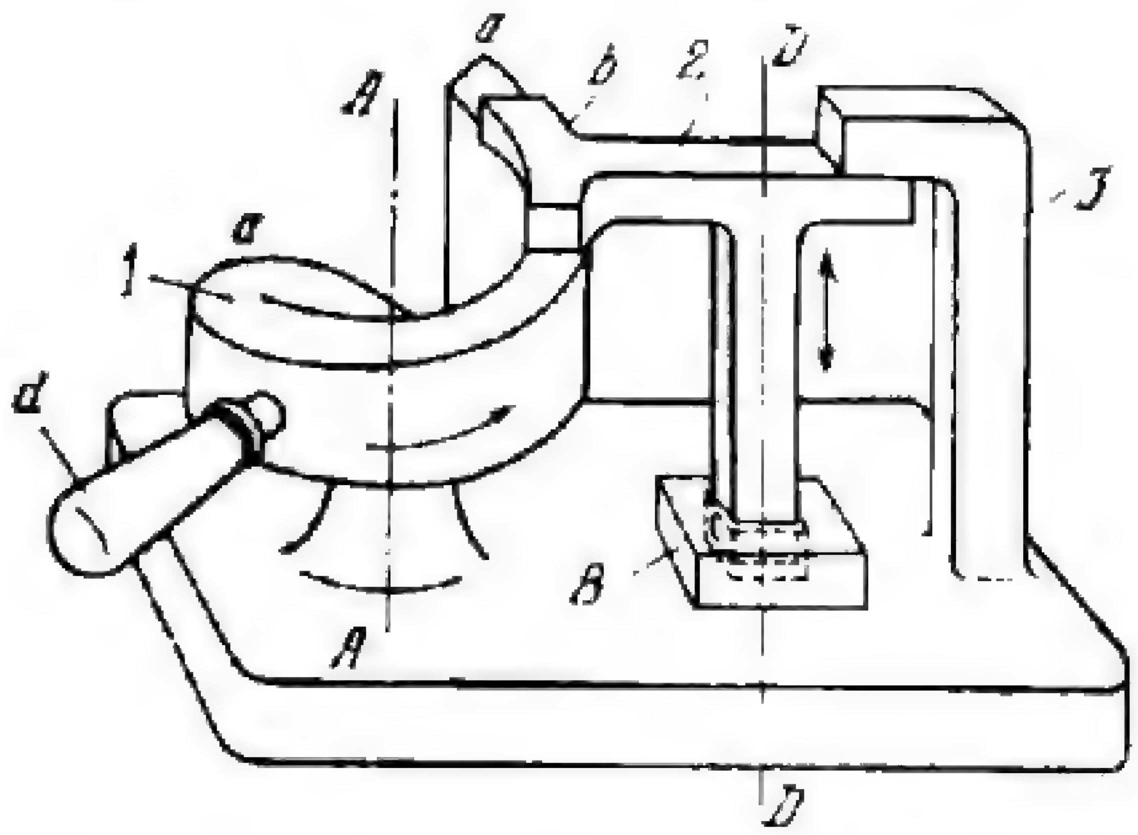
Round roller *1* rotates freely about fixed axis *D*. Cam *2* has contour *a* which rolls along roller *1*. Cam *2* is connected by turning pair *A* to rocker arm *3* which turns about fixed axis *B*. When cam *2* rotates about axis *A*, it has a complex motion, oscillating rocker arm *3* about axis *B*. Cam *2* is held in contact with roller *1* by spring *4*.

3030	THREE-LINK PLANE-PROFILE SPATIAL SIDE CAM MECHANISM	SmC 3L



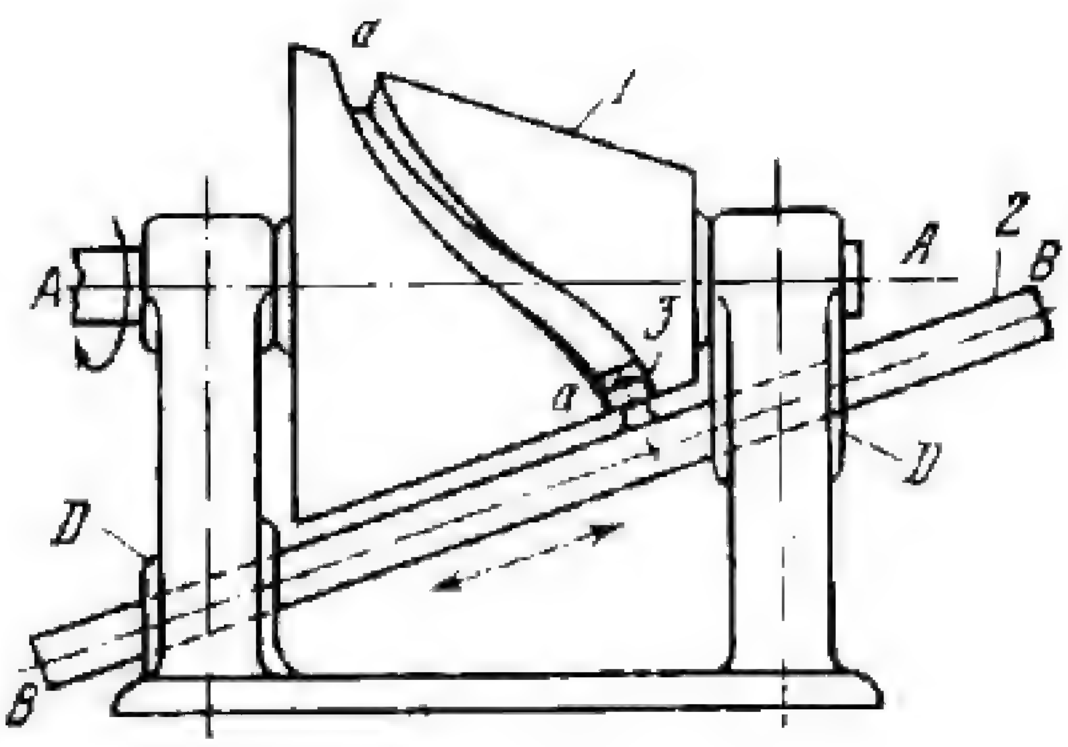
Cylindrical side cam *1* rotates about fixed axis *A-A*. Cam surface *a* is obtained by cutting a hollow cylinder with a plane making a certain angle with axis *A-A*. Follower *3* reciprocates in fixed guide *B* along axis *D-D*, parallel to axis *A-A*, and carries barrel-shaped roller *2* which rolls along surface *a* of cam *1*. Roller *2* is held in contact with cam *1* by gravity or by a special spring (not shown).

3031	THREE-LINK HELICAL-PROFILE SPATIAL SIDE CAM MECHANISM	SmC 3L



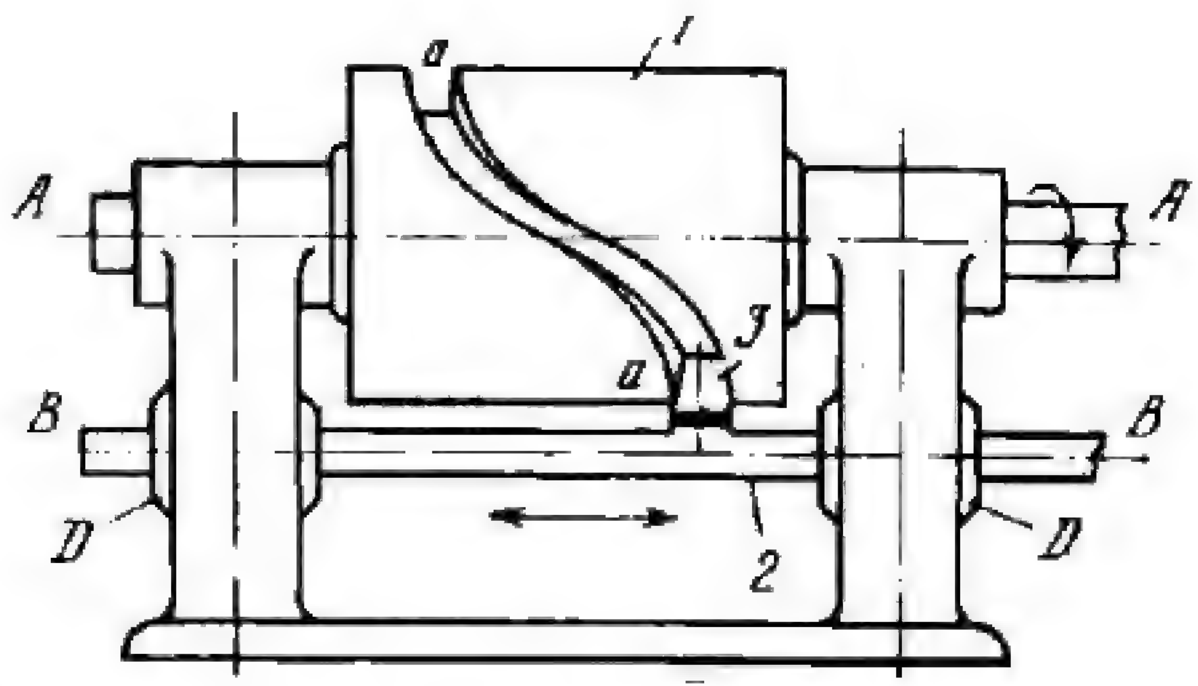
Cylindrical side cam *1* rotates about fixed axis *A-A*. Cam surface *a* is a helical surface. Follower *2* reciprocates in fixed guide *B* along axis *D-D*, parallel to axis *A-A*, and has head *b*. The lower surface of head *b*, in contact with cam *1*, is a helical surface identical to cam surface *a*. Link *3* limits the travel of follower *2*. Cam *1* is turned with handle *d*. The mechanism is used to clamp follower *2* in its extreme position between cam *1* and link *3*.

3032	THREE-LINK SPATIAL CONICAL CAM MECHANISM	SmC 3L



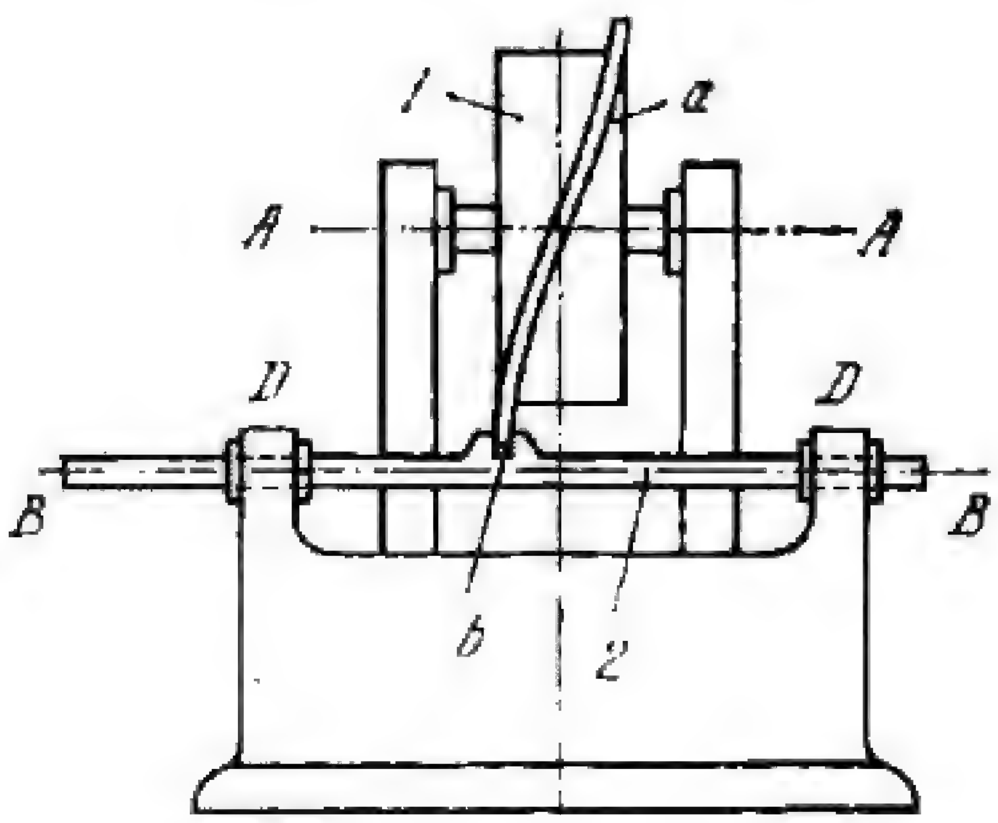
Conical cam *1* rotates about fixed axis *A-A* and has profiled groove *a-a*. Follower *2* reciprocates in fixed guides *D-D* and carries roller *3* which rolls and slides along groove *a-a*. Axis *B-B* of guides *D-D* is parallel to an element of the conical surface of cam *1*.

3033	THREE-LINK SPATIAL CYLINDER CAM MECHANISM	SmC 3L



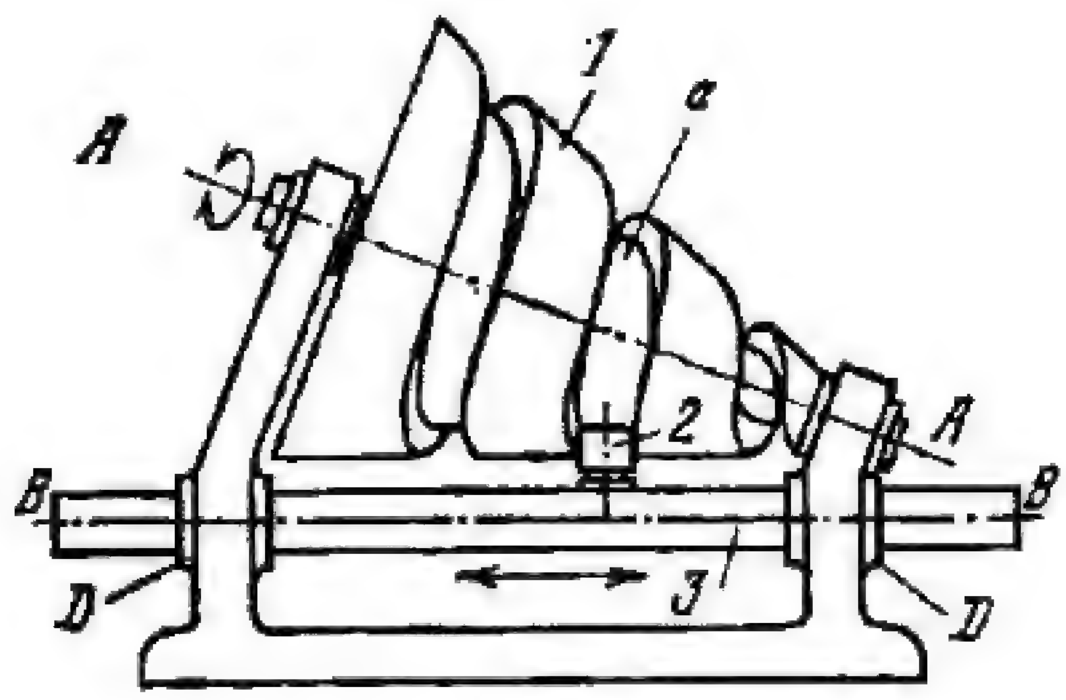
Cylinder cam *1* rotates about fixed axis *A-A* and has profiled groove *a-a*. Follower *2* reciprocates in fixed guides *D-D* and carries tapered roller *3* which rolls and slides along groove *a-a*. Axis *B-B* of guides *D-D* is parallel to axis *A-A*.

3034	THREE-LINK SPATIAL CYLINDRICAL RIDGE CAM MECHANISM	SmC 3L



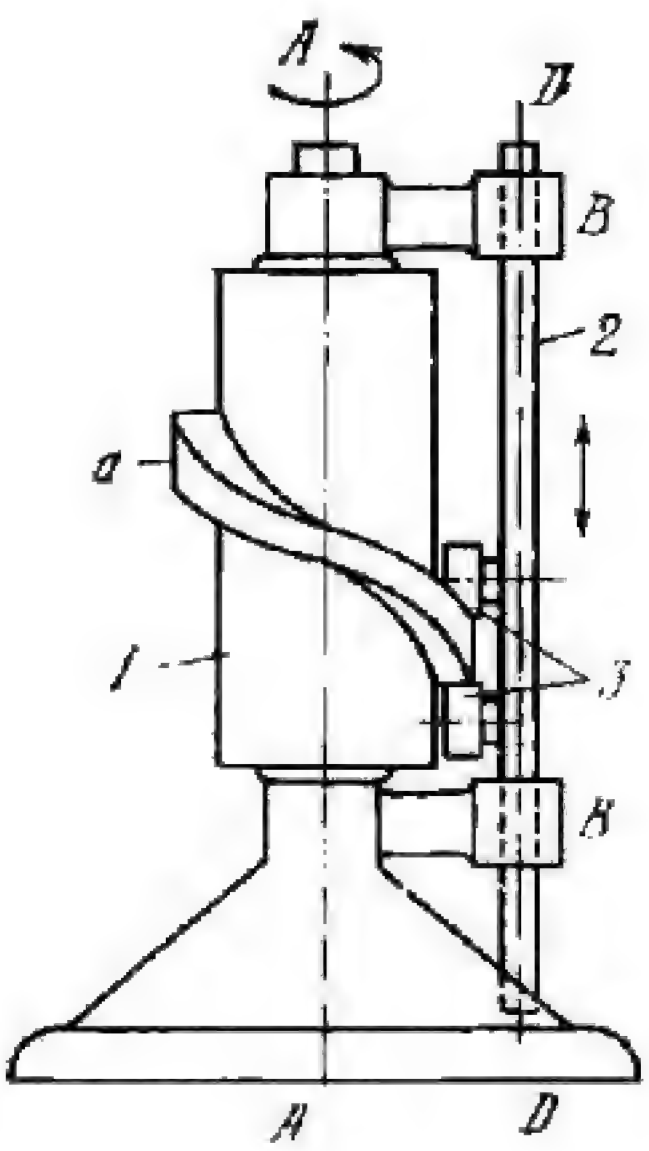
Cylinder cam *1* rotates about fixed axis *A-A* and has profiled ridge *a* which slides in slot *b* of follower *2*. Follower *2* reciprocates in fixed guides *D-D* whose axis *B-B* is parallel to axis *A-A*.

3035	THREE-LINK SPATIAL CONICAL CAM MECHANISM WITH A HELICAL GROOVE	SmC 3L



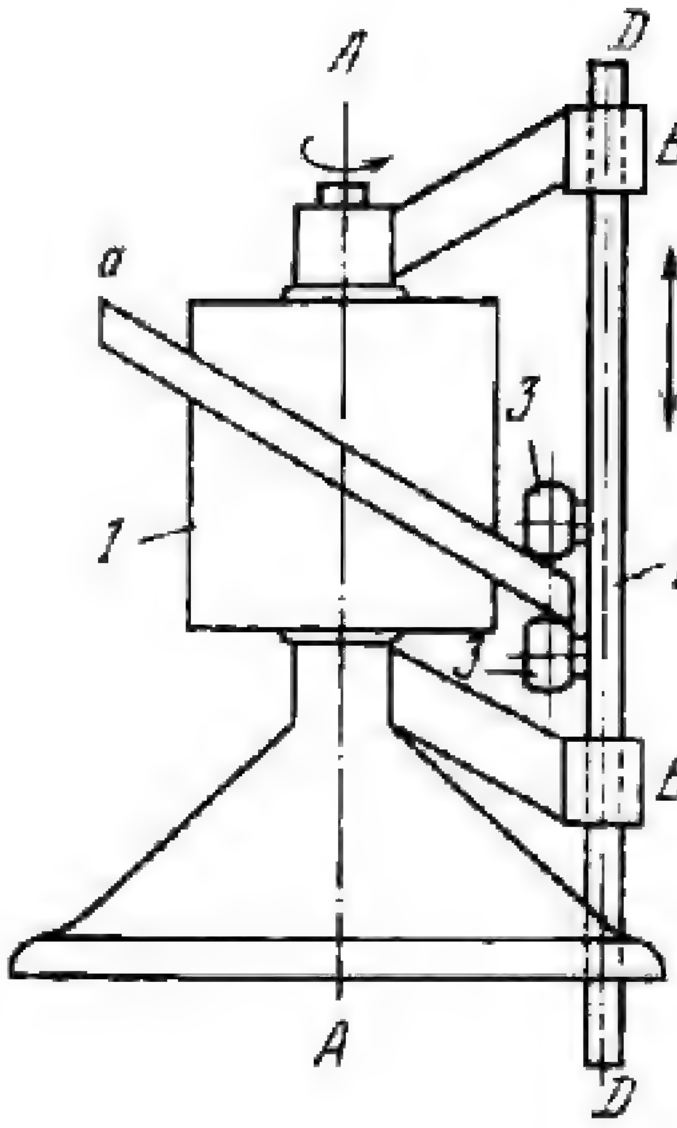
Conical cam *1* rotates about fixed axis *A-A* and has profiled helical groove *a*. Follower *3* reciprocates in fixed guides *D-D* and carries roller *2* which rolls and slides along groove *a*. Axis *B-B* of guides *D-D* is parallel to an element of the conical surface of cam *1*. A full cycle corresponds to several revolutions of cam *1*, the number depending upon the pitch and number of turns of helical groove *a*.

3036	THREE-LINK SPATIAL CYLINDER CAM MECHANISM WITH A HELICAL RIDGE	SmC 3L



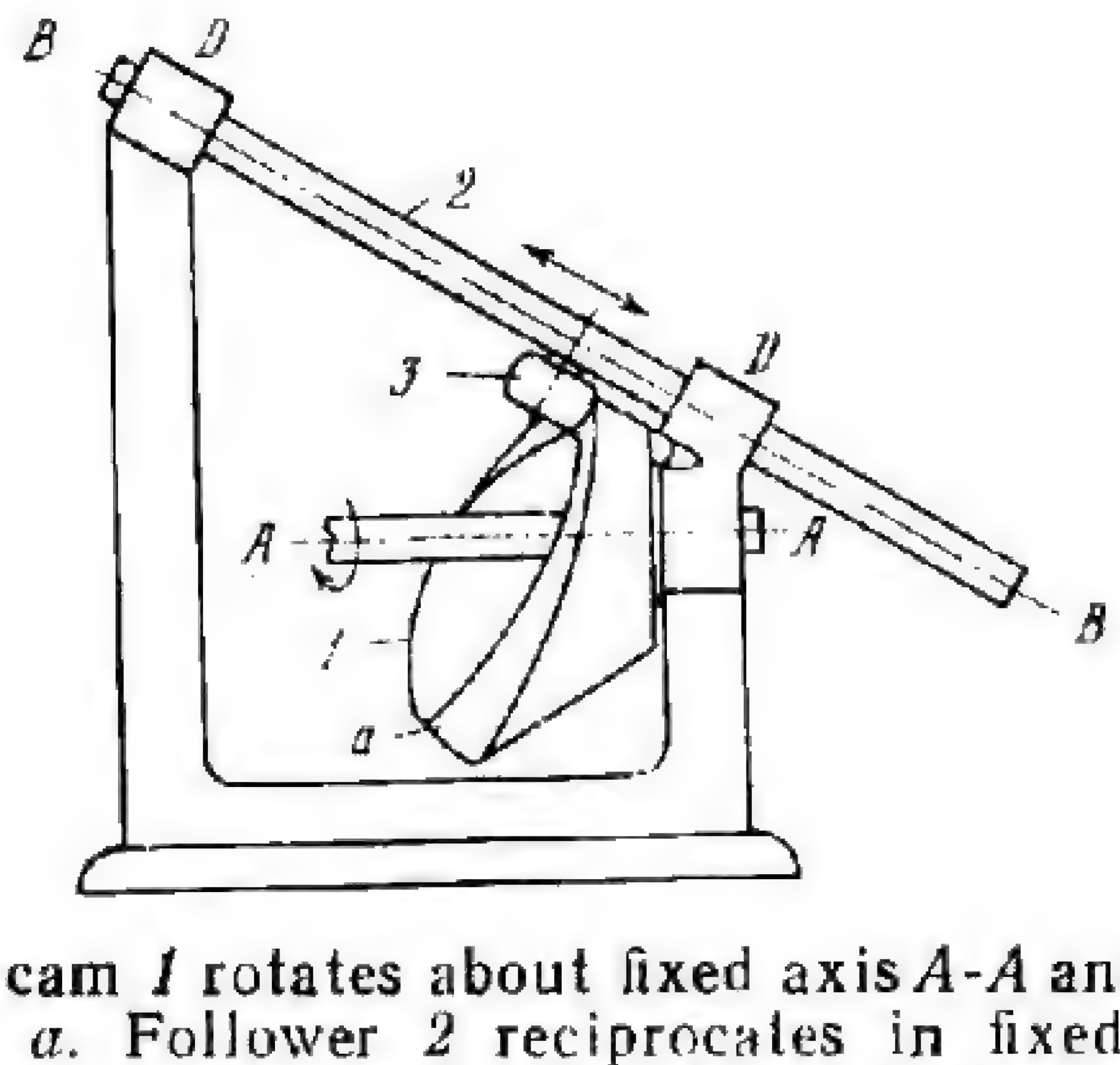
Cylinder cam *1* rotates about fixed axis *A-A* and has profiled helical ridge *a*. Follower *2* reciprocates in fixed guides *B-B* whose axis *D-D* is parallel to axis *A-A*. Follower *2* carries two rollers *3* which roll along the upper and lower side surfaces of ridge *a*. Positive motion is achieved because the vertical distance between the theoretical, or pitch, curves of the side surfaces of ridge *a* is constant and equal to the distance between the centres of rollers *3*. The type of motion of the follower depends upon whether helical ridge *a* has a constant or variable pitch.

3037	THREE-LINK SPATIAL CYLINDRICAL RIDGE CAM MECHANISM OF THE SLANTED WASHER TYPE	SmC 3L



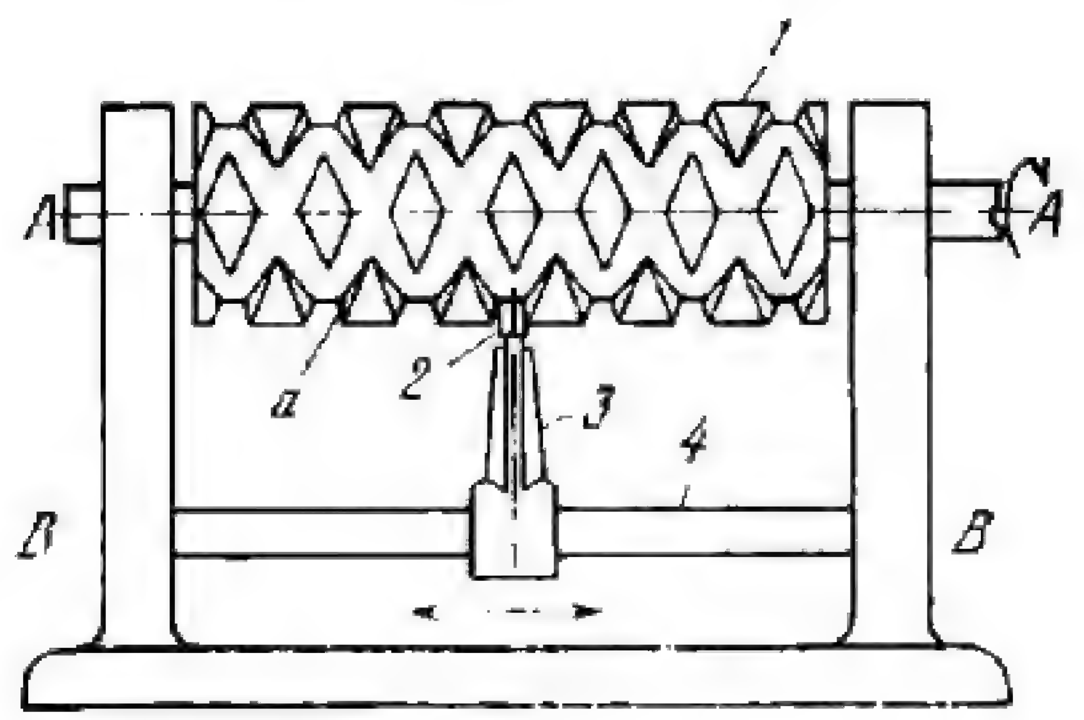
Cylinder cam *1* rotates about fixed axis *A-A* and is rigidly attached to (or integral with) slanted washer *a* which is the cam ridge. Follower *2* reciprocates in fixed guides *B-B* whose axis *D-D* is parallel to axis *A-A*. Follower *2* carries two barrel-shaped rollers *3* which roll along the upper and lower side surfaces of slanted washer *a*. Positive motion is achieved because the side surfaces of washer *a* are parallel and the vertical distance between their theoretical, or pitch, curves is equal to the distance between the centres of rollers *3*. When cam *1* rotates at constant speed, follower *2* travels at constant velocity. The full stroke and velocity of follower *2* depend upon the angle of inclination of the surfaces of washer *a* to axis *A-A*.

3038	THREE-LINK SPATIAL CONICAL SIDE CAM MECHANISM WITH A BARREL-SHAPED ROLLER	SmC 3L



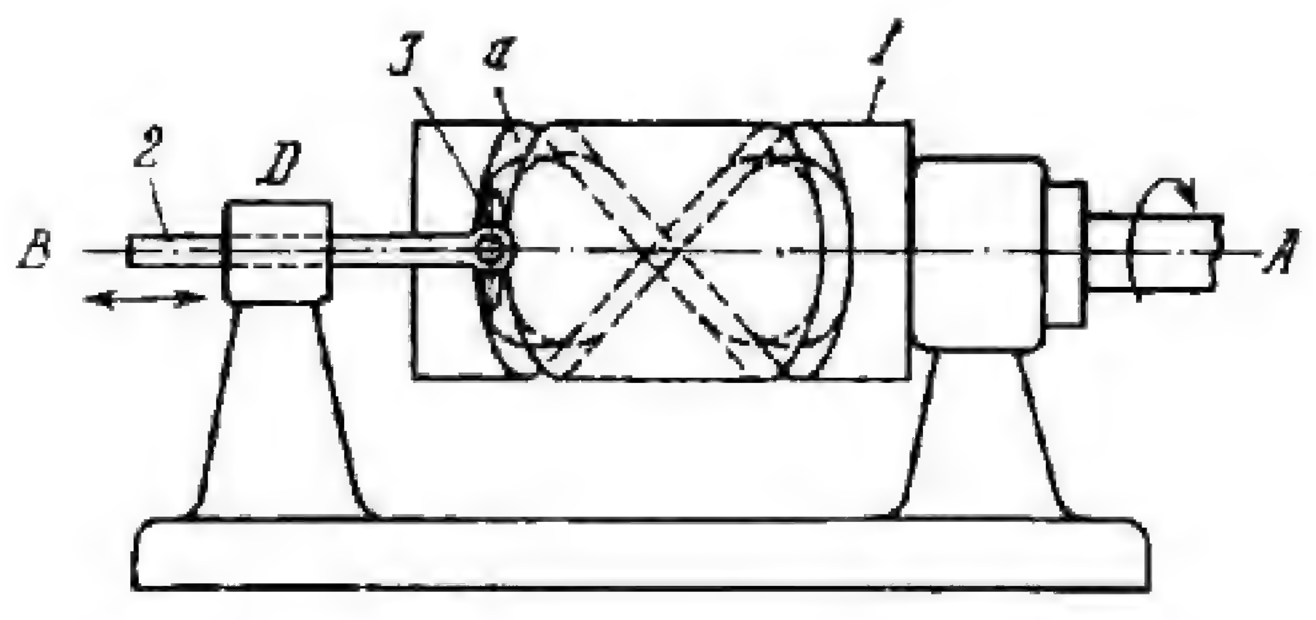
Conical side cam *1* rotates about fixed axis *A-A* and has profiled cam surface *a*. Follower *2* reciprocates in fixed guides *D-D* and carries barrel-shaped roller *3* which rolls along cam surface *a*. Axis *B-B* of guides *D-D* is parallel to an element of the conical surface of cam *1*. Roller *3* has point contact with cam surface *a*. Roller *3* is held in contact with cam *1* by a spring (not shown).

3039	THREE-LINK SPATIAL CROSS-GROOVED CYLINDER CAM MECHANISM	SmC 3L



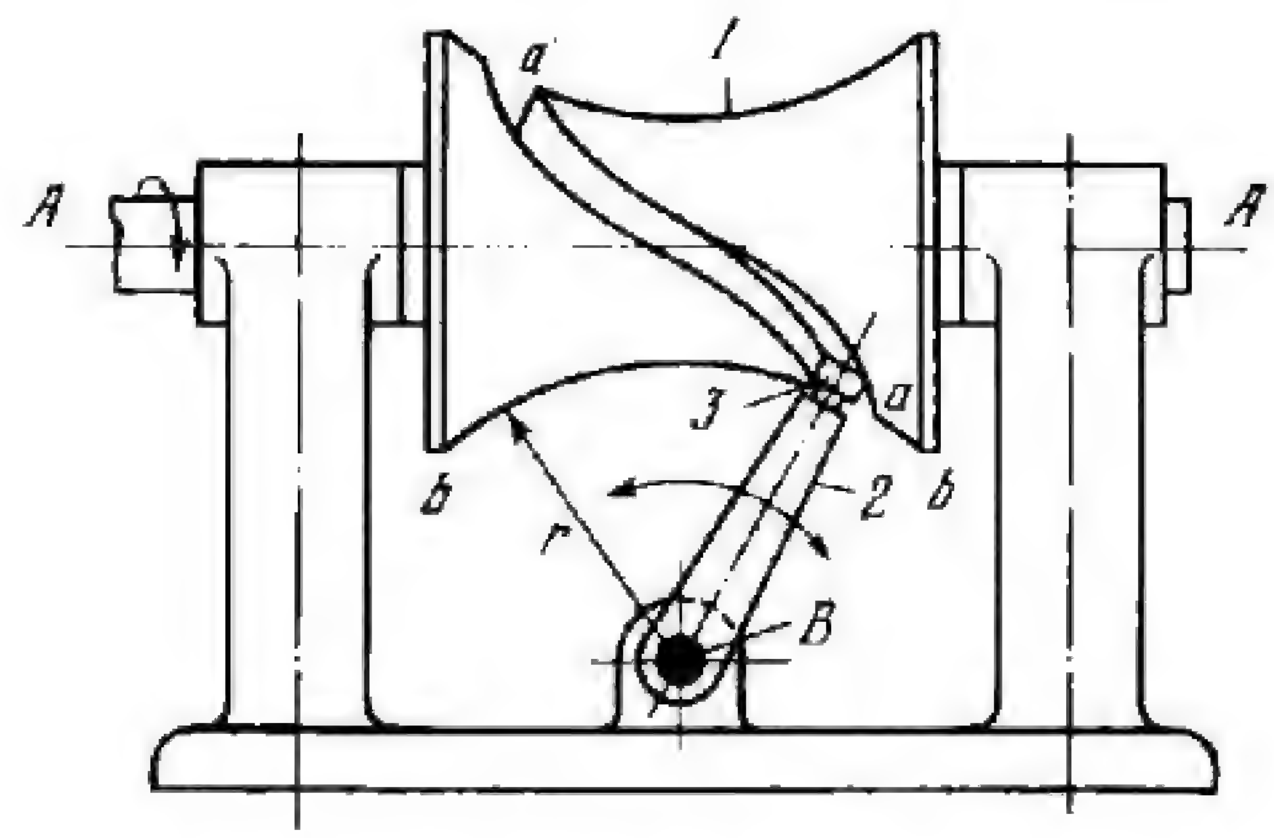
Cylinder cam *1* rotates about fixed axis *A-A* and has helical groove *a* with right- and left-hand portions of constant pitch. Follower *3* reciprocates along fixed guide *4* and carries pivoted lens-shaped member *2* which slides along groove *a*. When cam *1* rotates at constant speed, follower *3* travels at constant velocity. At its extreme positions, follower *3* is automatically reversed, being switched over from right- to left-hand portions of the groove or vice versa. This provides for continuous motion of follower *3*. Axis *B-B* of follower travel is parallel to axis *A-A*.

3040	THREE-LINK SPATIAL CYLINDER CAM MECHANISM WITH A FIGURE-OF-EIGHT GROOVE	SmC 3L



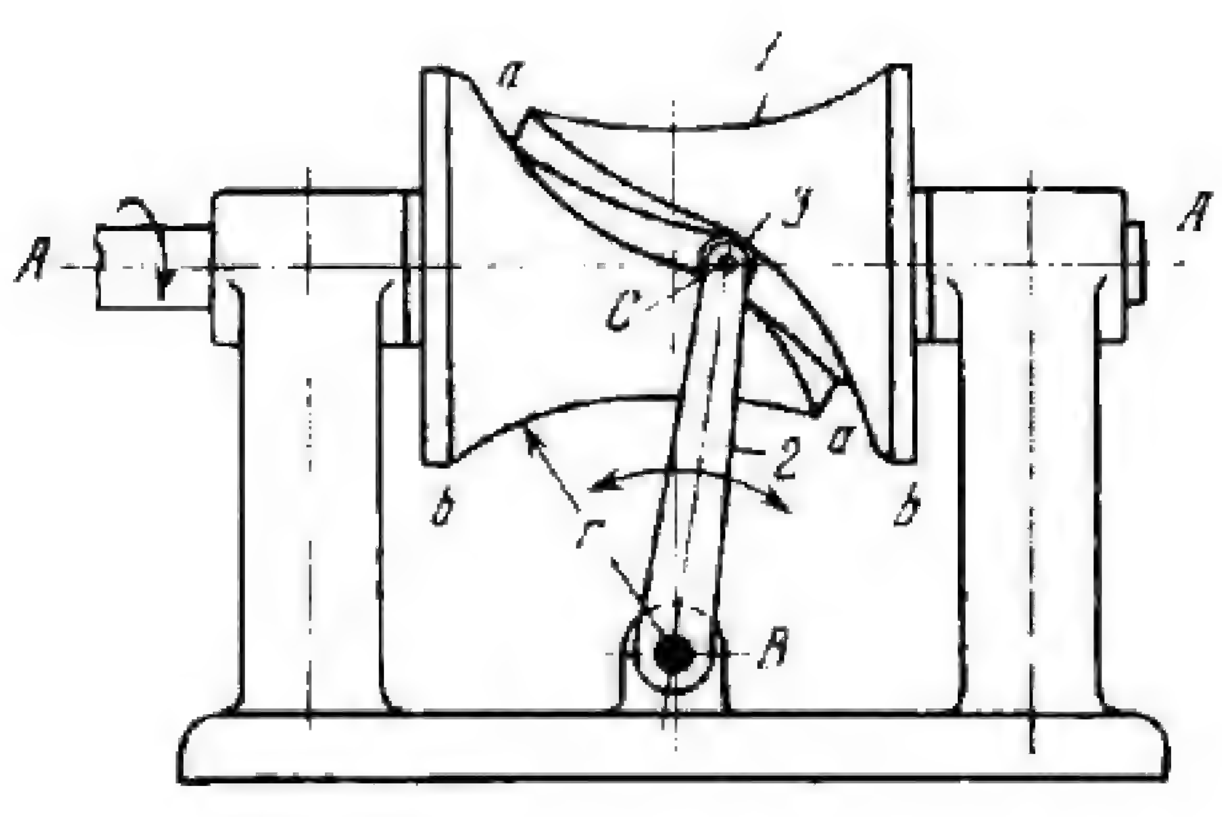
Cylinder cam *1* rotates about fixed axis *A* and has groove *a* whose projection on the plane of the drawing has a figure-of-eight shape. Follower *2* reciprocates in fixed guide *D* and carries pivoted lens-shaped member *3* which slides along groove *a*. Follower *2* may have various types of motion depending upon the profile of groove *a*. Axis *B* of follower travel is parallel to axis *A*.

3041	**THREE-LINK SPATIAL GLOBOIDAL CAM MECHANISM**	SmC 3L



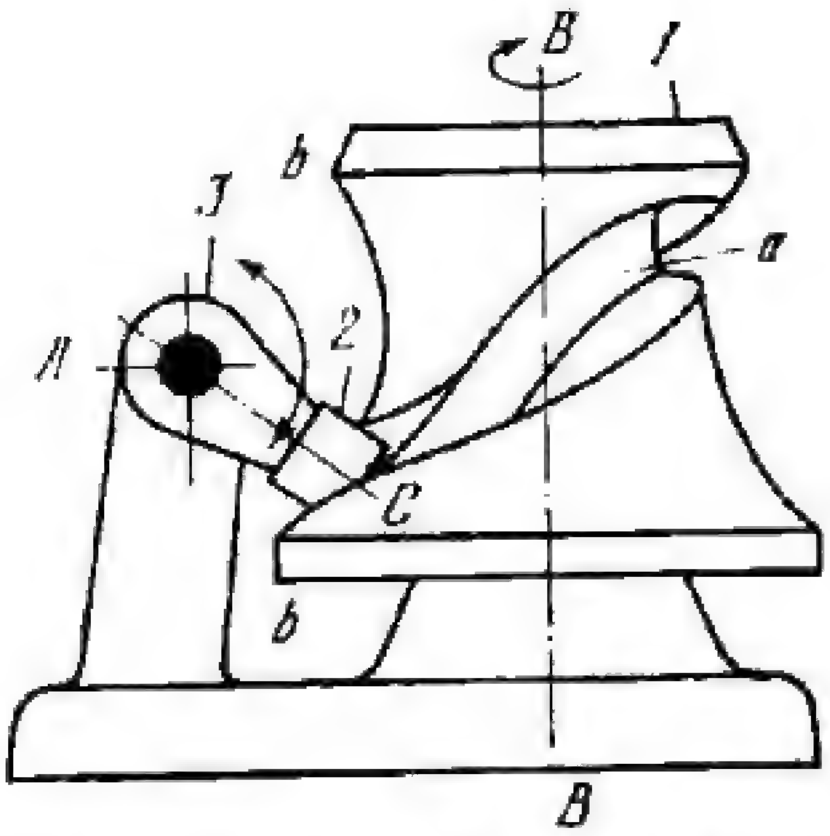
Cam *1* rotates about fixed axis *A-A* and its globoidal surface, in which cam groove *a-a* is machined, is generated by the revolution of circular arc *b-b* of radius *r* about axis *A-A*. Follower *2* oscillates about fixed axis *B* and carries roller *3* which rolls and slides along groove *a-a*. The plane of oscillation of follower *2* contains the axis of roller *3* and passes through axis *A-A*.

3042	**THREE-LINK SPATIAL GLOBOIDAL CAM MECHANISM**	SmC 3L



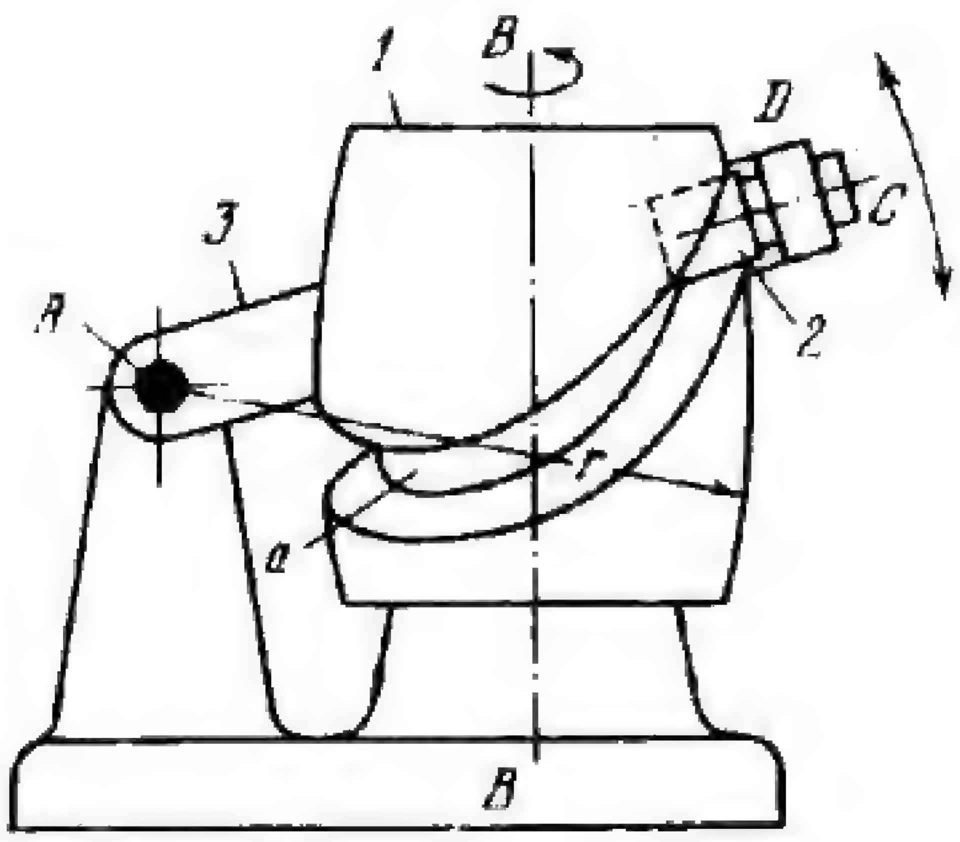
Cam *1* rotates about fixed axis *A-A* and its globoidal surface, in which cam groove *a-a* is machined is generated by the revolution of circular arc *b-b* of radius *r* about axis *A-A*. Follower *2* oscillates about fixed axis *B* and carries roller *3* which rolls and slides along groove *a-a*. Axis *C* of rotation of roller *3* is parallel to axis *B*. Axes *A-A* and *B* are perpendicular to each other and the plane of oscillation of follower *2* is parallel to axis *A-A*.

3043	THREE-LINK SPATIAL HYPERBOLOID CAM MECHANISM	SmC 3L



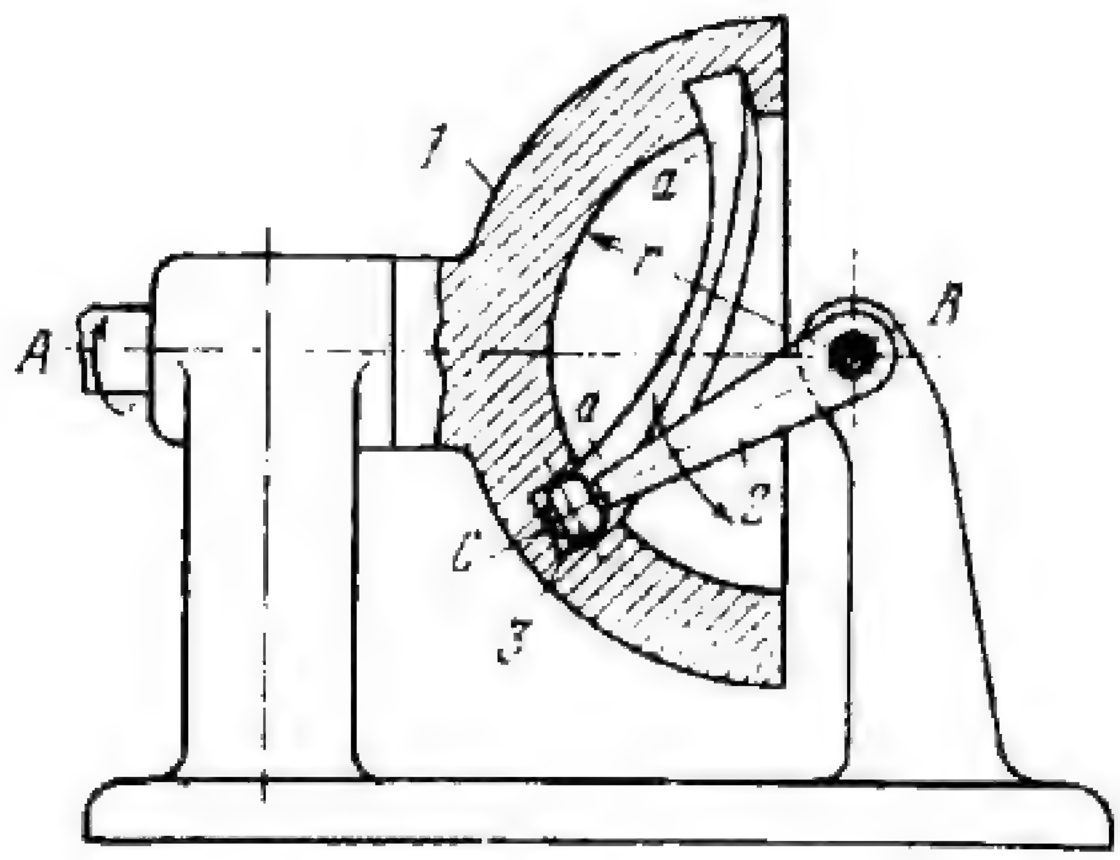
Cam *1* rotates about fixed axis *B-B* and its hyperboloid surface, in which cam groove *a* is machined, is generated by the revolution of arc *b-b* of a hyperbola about axis *B-B*. Follower *3* oscillates about fixed axis *A* and carries roller *2* which rolls and slides along groove *a*. Axes *A* and *C* of follower and roller rotation intersect and are perpendicular to each other. The plane of oscillation of follower *3* passes through axis *B-B*.

3044	THREE-LINK SPATIAL CONVEX GLOBOIDAL CAM MECHANISM	SmC 3L



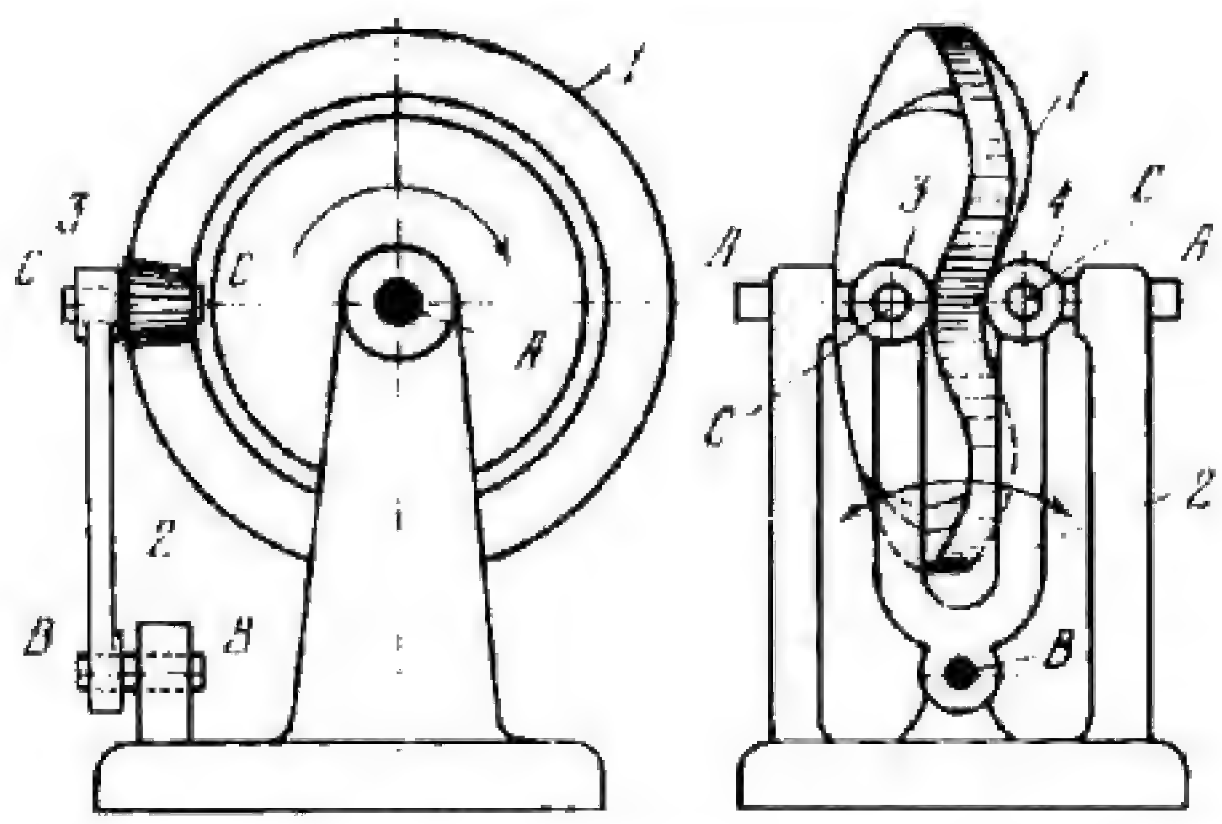
Cam *1* rotates about fixed axis *B-B* and its convex globoidal surface, in which cam groove *a* is machined, is generated by the revolution of a circular arc of radius *r* about axis *B-B*. Follower *3* oscillates about fixed axis *A* and carries roller *2* which rolls and slides along groove *a*. Roller *2* rotates about axis *C* of bearing *D* on follower *3*. Axes *A* and *C* of follower and roller rotation intersect and are perpendicular to each other. The plane of oscillation of follower *3* is parallel to axis *B-B*.

3045	THREE-LINK SPATIAL INTERNAL SPHERICAL CAM MECHANISM	SmC 3L



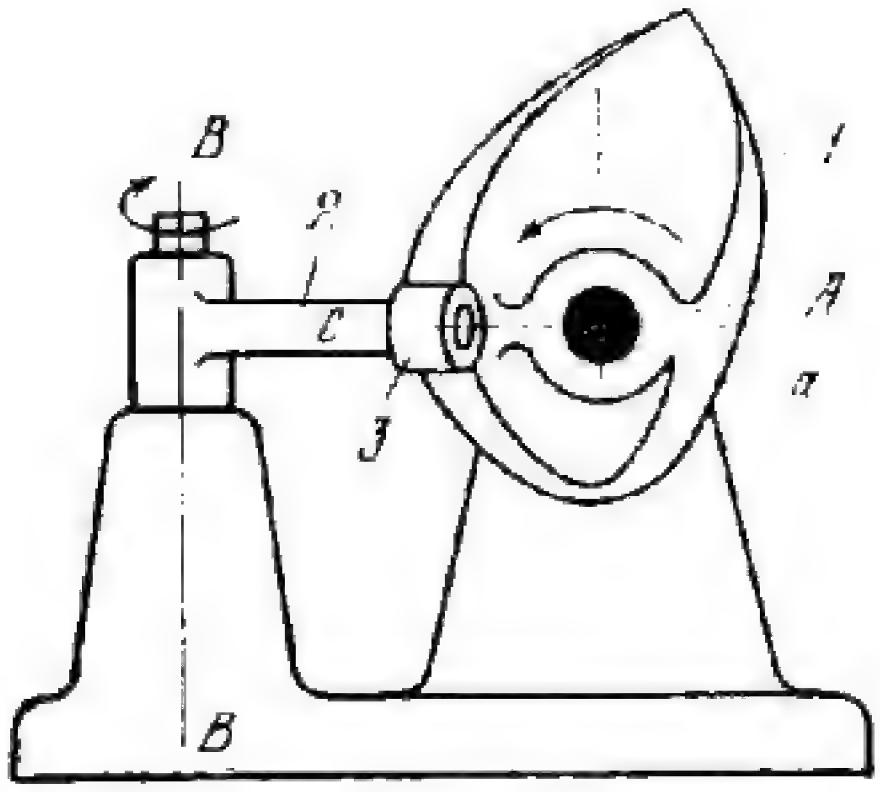
Cam *1* rotates about fixed axis *A* and its surface, in which cam groove *a-a* is machined, is an internal spherical surface of radius *r*. Follower *2* oscillates about fixed axis *B* and carries roller *3* which rolls and slides along groove *a-a*. Roller *3* rotates about axis *C*. Axes *B* and *C* of follower and roller rotation intersect and are perpendicular to each other, as are axes *A* and *B* of cam and follower rotation. Thus, the axes of rotation of all the links intersect at a common point which is the centre of the spherical surface of radius *r*.

3046	THREE-LINK SPATIAL CYLINDRICAL RIDGE CAM MECHANISM OF THE NONPLANAR SLANTED WASHER TYPE	SmC 3L



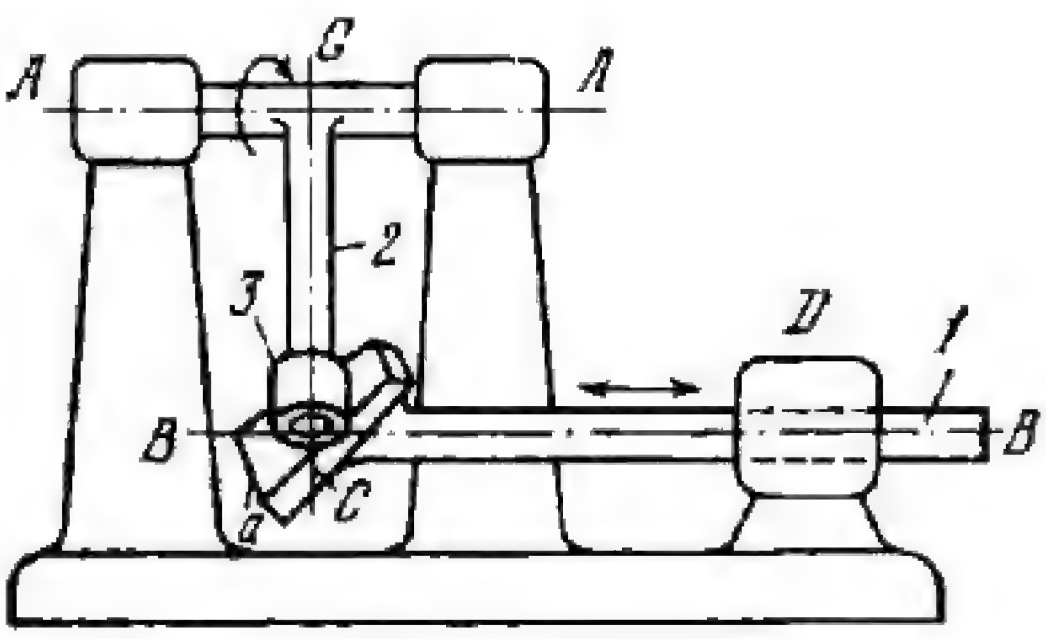
Cylinder cam *1* rotates about fixed axis *A-A* and its ridge is designed as a nonplanar slanted washer. Follower *2* oscillates about fixed axis *B-B* and carries two rollers, *3* and *4*, which roll along the side surfaces of the ridge of cam *1*. Axes *C* of rotation of rollers *3* and *4* intersect and are perpendicular to axis *A-A*. Axes *A-A* and *B-B* are perpendicular to each other. Positive motion is achieved by the two rollers, *3* and *4*.

3047	**THREE-LINK SPATIAL SIDE CAM MECHANISM WITH CROSSED CAM AND FOLLOWER AXES**	SmC 3L



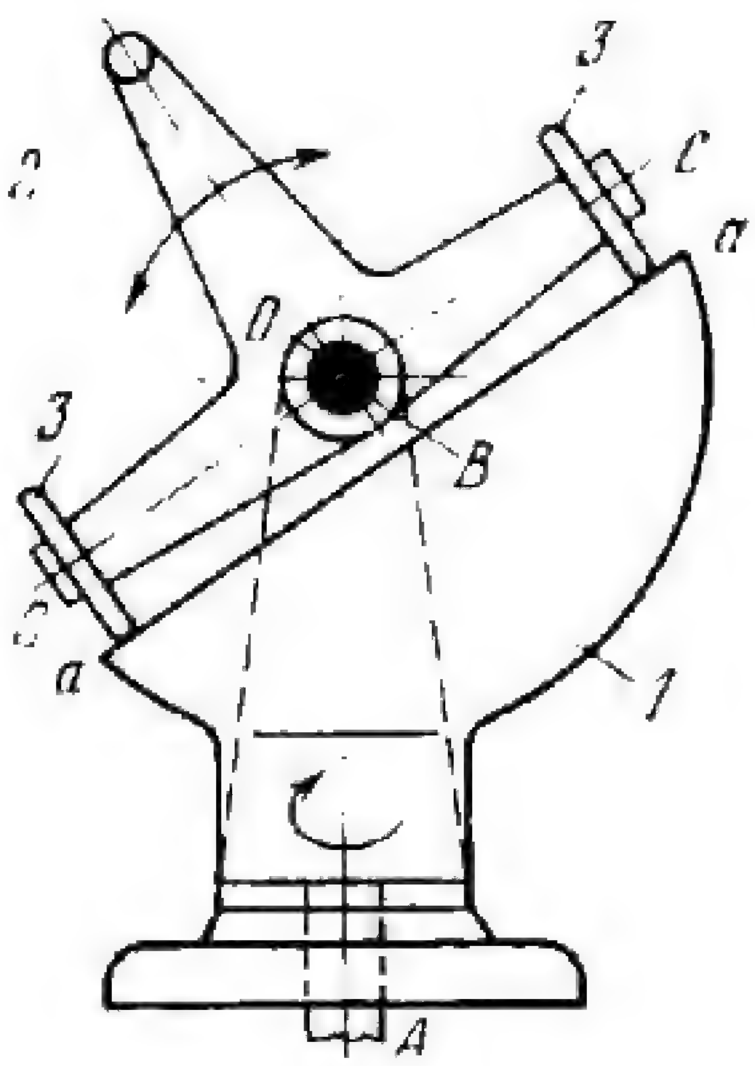
Cam *1* rotates about fixed axis *A* and has curvilinear cam surface *a*. Follower *2* oscillates about fixed axis *B-B* and carries roller *3* which rolls along cam surface *a*. Axis *C* of roller rotation intersects and is perpendicular to axis *B-B*. Axes *A* and *B-B* of cam and follower rotation are crossed and perpendicular to each other. Roller *3* is held in contact with cam *1* by a spring (not shown).

3048	**THREE-LINK SPATIAL INVERSE SLIDING CAM MECHANISM WITH A PLANE CAM SURFACE**	SmC 3L



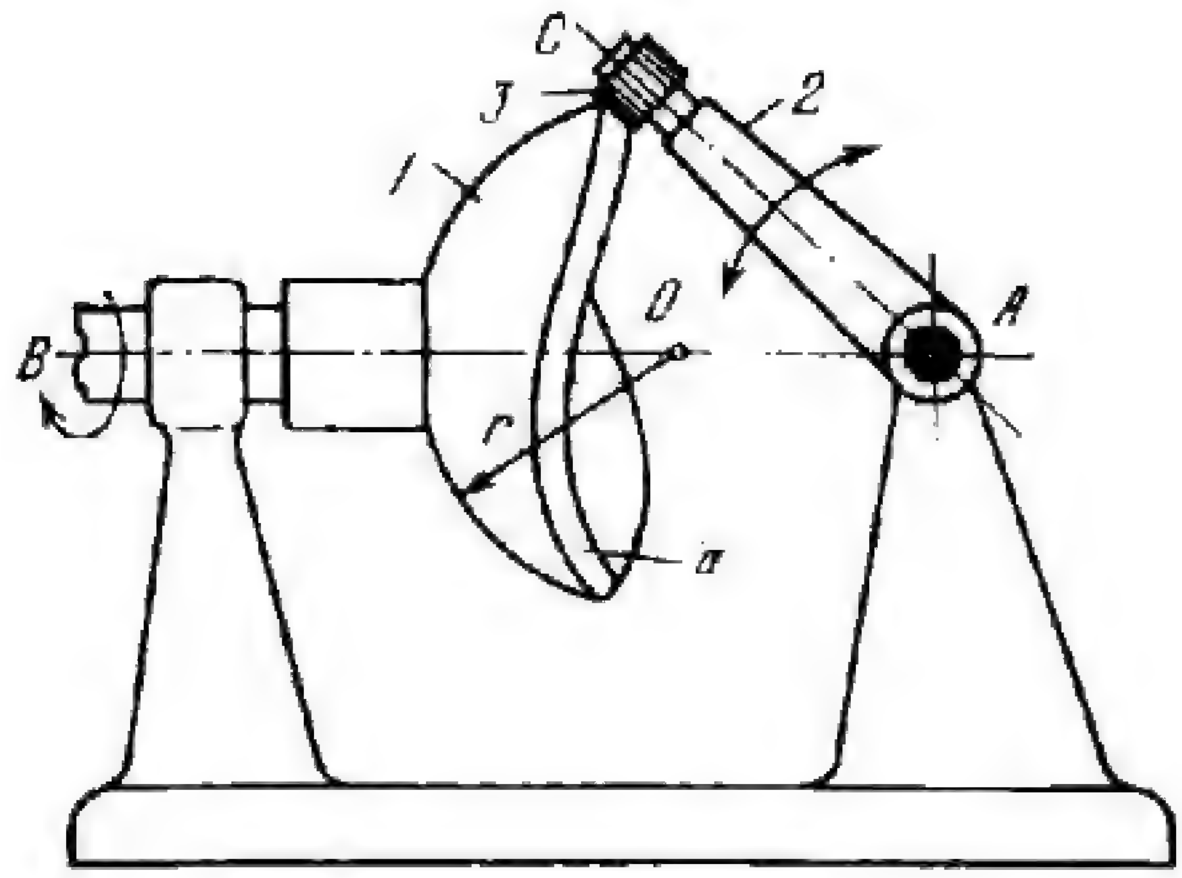
Cam *1* reciprocates in fixed guide *D* along axis *B-B*. Cam surface *a* is a plane inclined at a certain angle to axis *B-B*. Follower *2* oscillates about fixed axis *A-A* and carries roller *3* which rotates freely about axis *C-C* of follower *2* and rolls along cam surface *a*. Axes *A-A* and *C-C* intersect and are perpendicular to each other. Axis *B-B* of cam motion is parallel to axis *A-A* of follower oscillation. Roller *3* is held in contact with cam surface *a* by a spring (not shown).

3049	**THREE-LINK SPHERICAL CAM MECHANISM OF THE SLANTED WASHER TYPE**	SmC 3L



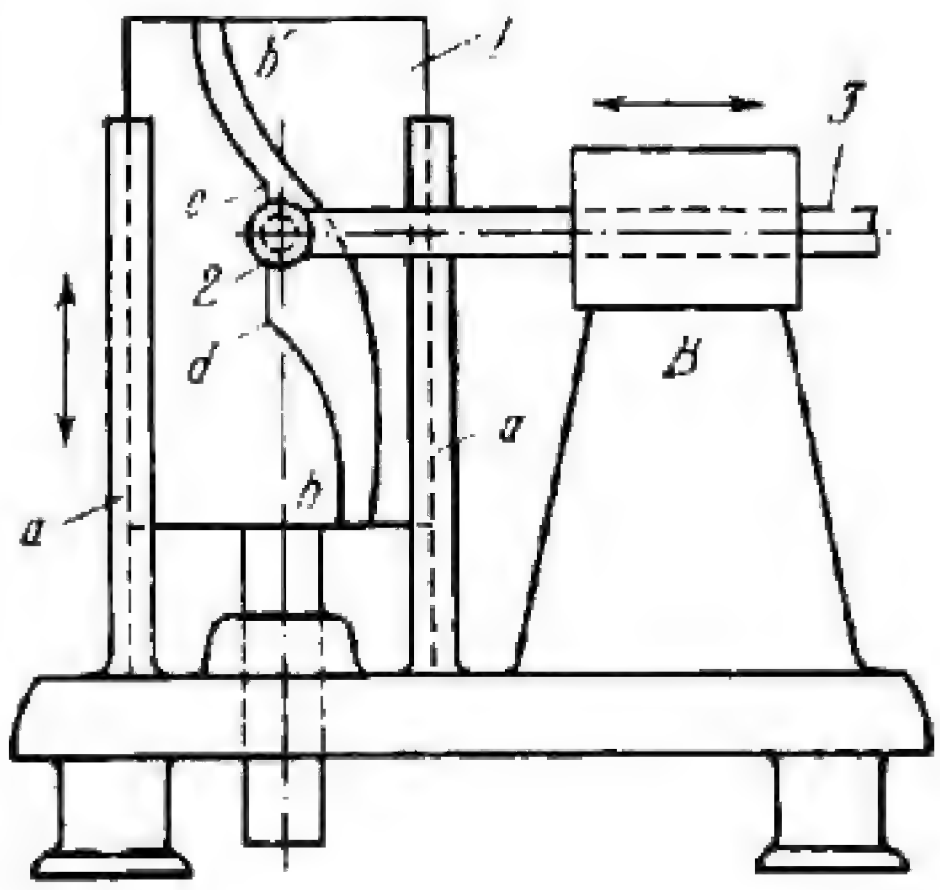
Cam *1* rotates about fixed axis *A* and is designed as slanted washer *a-a*. Follower *2* oscillates about fixed axis *B* and carries rollers *3* which rotate freely about axis *C-C* of follower *2* and roll along cam surface *a-a*. Axes *A*, *B* and *C-C* intersect at common point *O*. Rollers *3* are held in contact with cam surface *a-a* by a spring (not shown).

3050	**THREE-LINK SPATIAL SPHERICAL CAM MECHANISM**	SmC 3L



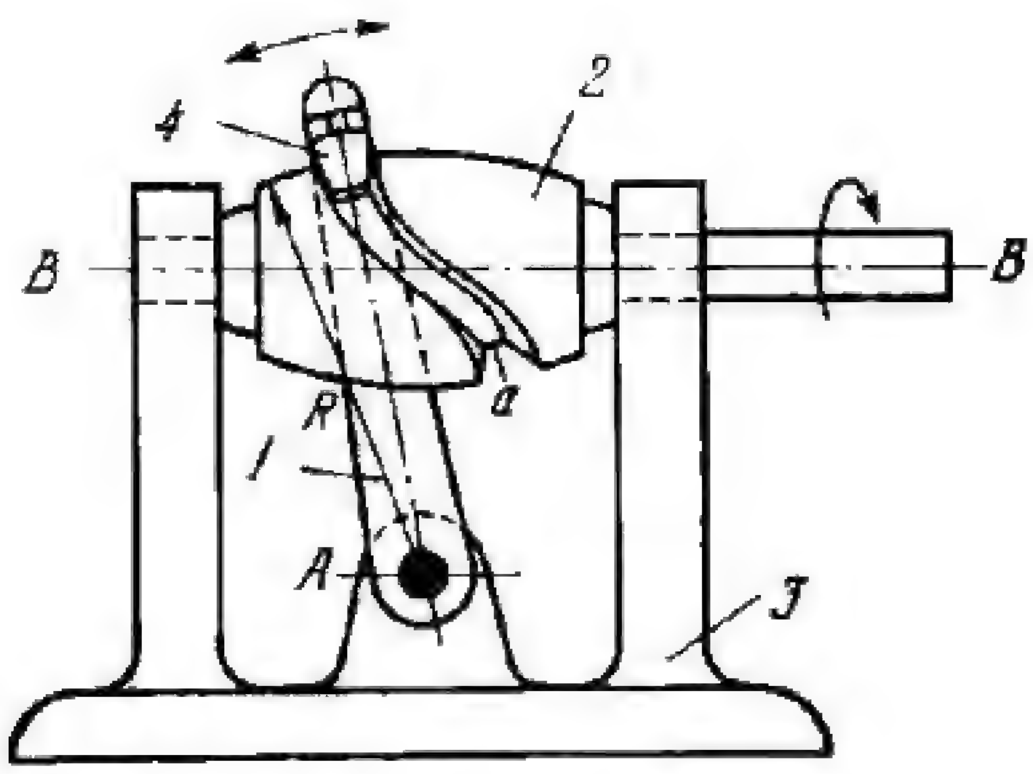
Cam *1* rotates about fixed axis *B* and its external surface is a spherical surface of radius *r*. Elements of cam surface *a* are straight lines passing through point *A*. Follower *2* oscillates about fixed axis *A* and carries tapered roller *3* which rotates freely about axis *C* of follower *2* and rolls along cam surface *a*. Axes *A*, *B* and *C* intersect at a common point. Roller *3* is held in contact with cam *1* by a spring (not shown).

3051	THREE-LINK TWO-PROFILE SLIDING CAM MECHANISM	SmC 3L



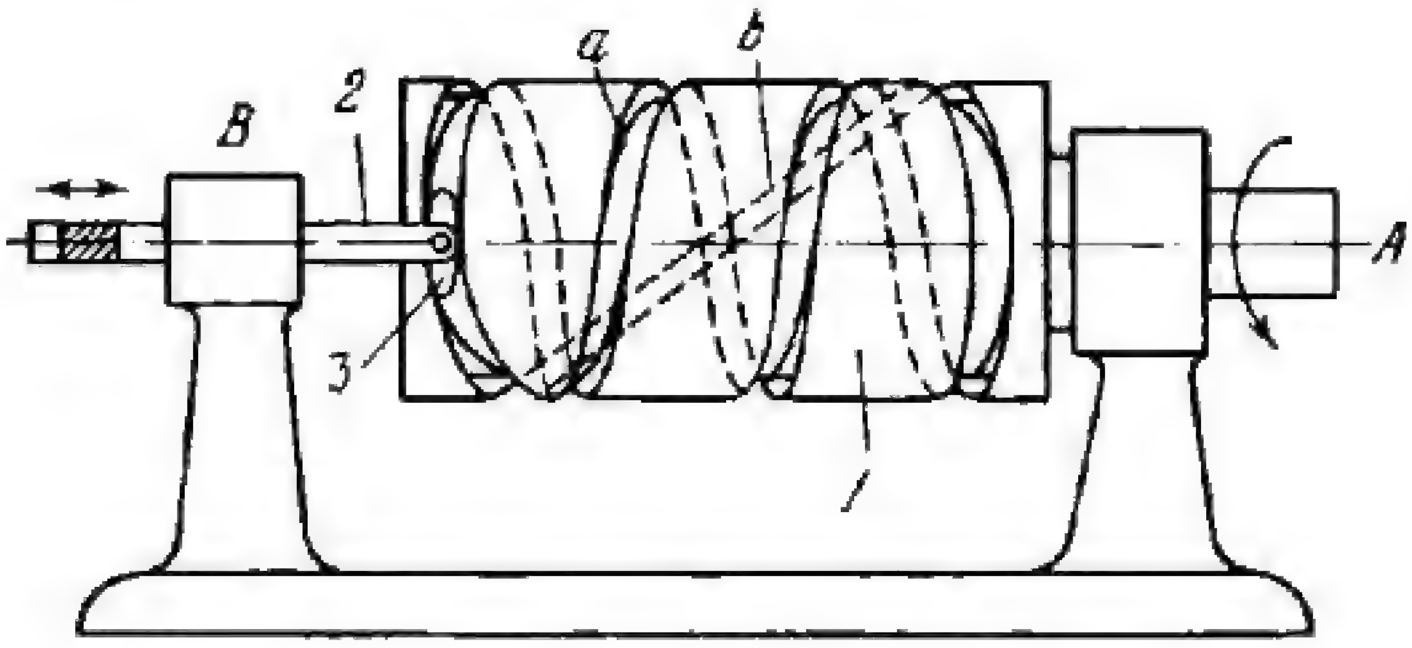
Cam *1* reciprocates in fixed guides *a-a* and has two profiled cam surfaces *b* and *b'*. Follower *3* reciprocates in fixed guide *B* and carries roller *2* which rolls along cam surface *b* during the upstroke of cam *1* and along cam surface *b'* during the downstroke. Cam surfaces *b* and *b'* have different profiles. Follower *3* has a long dwell while roller *2* rolls along portion *cd* of cam surface *b*. There is sufficient friction in the mechanism to keep roller *2* in contact with surfaces *b* and *b'* on the upward and downward motions of cam *1*.

3052	THREE-LINK INVERSE GLOBOIDAL CAM MECHANISM	SmC 3L



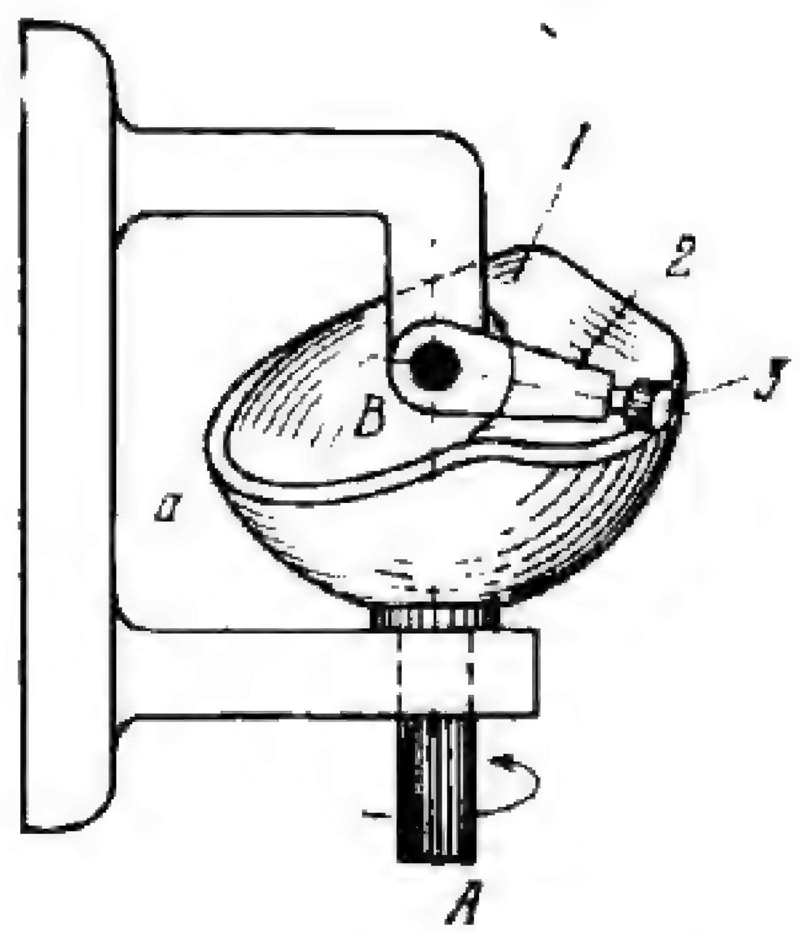
Rocker arm *1* oscillates about fixed axis *A* and is the driver. It carries tapered roller *4* which rolls and slides along helical groove *a* of cam *2*. The convex globoidal surface of cam *2* is generated by the revolution of a circular arc of radius *R* about axis *B-B*. Cam *2* rotates about fixed axis *B-B*. Transmission of motion from driver *1* to cam *2* is possible only if groove *a* has a sufficiently large helix angle. During one full cycle of motion, cam *2* makes one revolution.

3053	THREE-LINK SPATIAL QUICK-RETURN CYLINDER CAM MECHANISM	SmC 3L



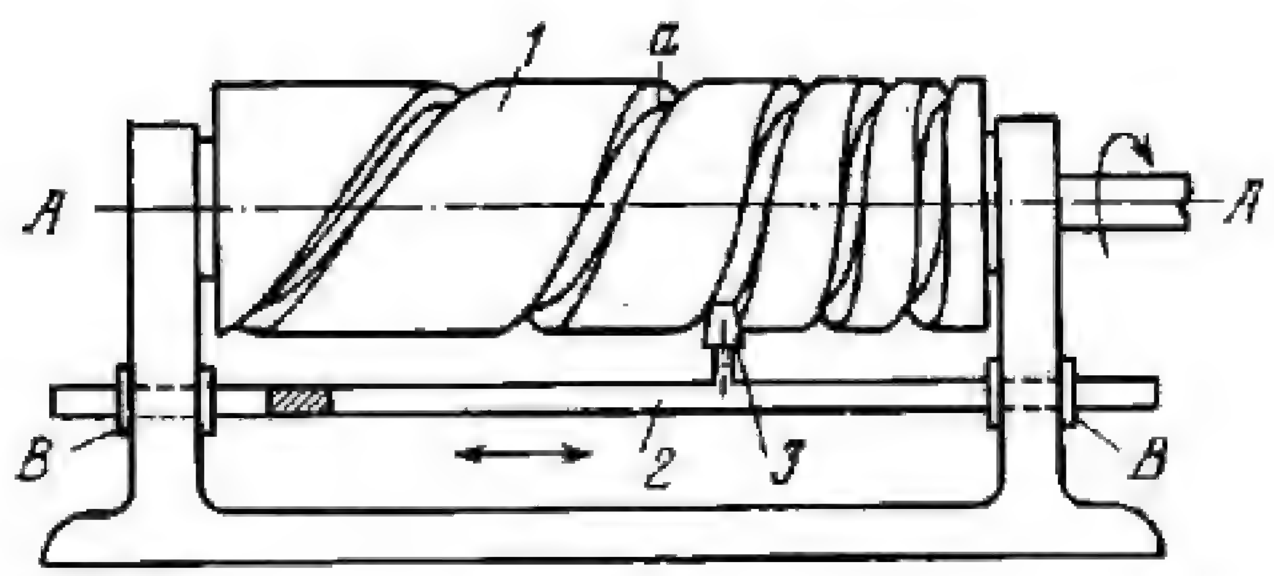
Cam *1* rotates about fixed axis *A* and has groove *a* with three points of self-intersection of the theoretical, or pitch, curve of the groove. Follower *2* reciprocates in fixed guide *B* and carries pivoted lens-shaped member *3* which slides along groove *a*. Groove *a* has three helical turns of constant pitch for slow motion of follower *2* to the right at constant velocity. From its extreme right-hand position, follower *2* travels rapidly to its extreme left-hand position because member *3* slides along portion *b* of the groove. This portion is a helical half-turn milled in the rear half (as shown) of the cylindrical surface of cam *1*.

3054	THREE-LINK SPATIAL SPHERICAL CAM MECHANISM	SmC 3L



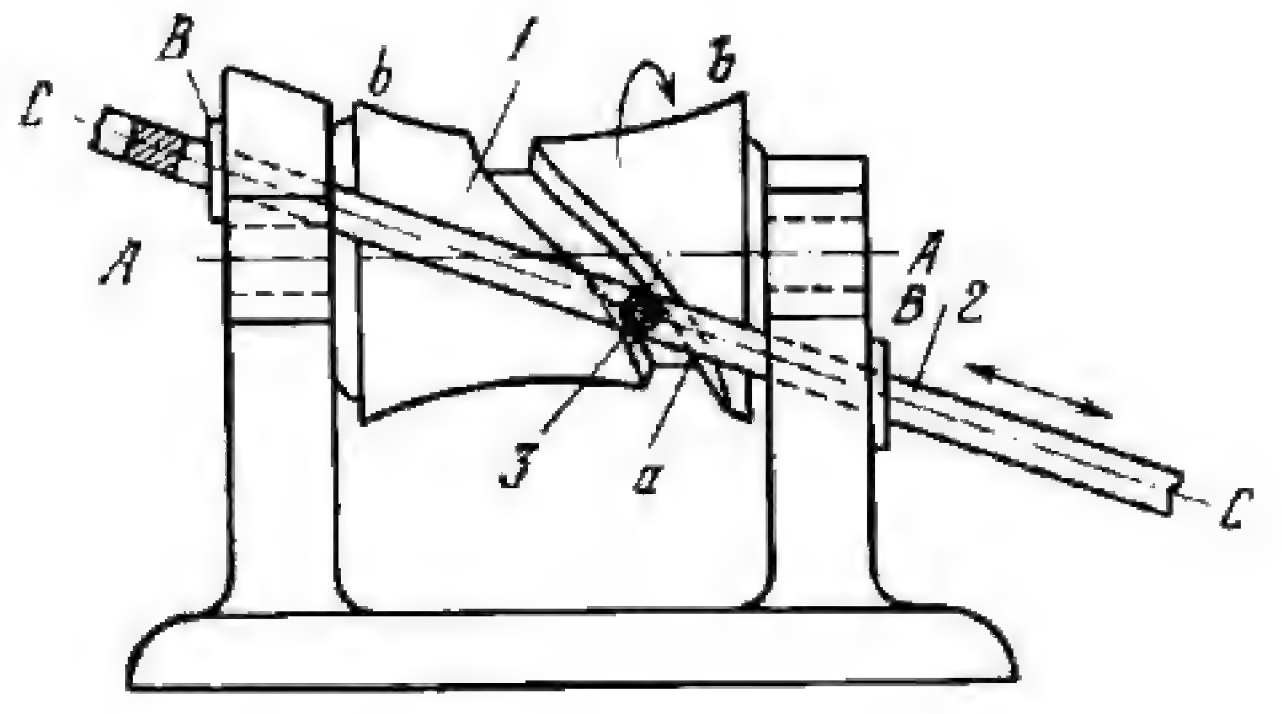
Spherical cam *1* rotates about fixed axis *A* and has cam surface *a* whose elements are straight lines passing through centre *B* of the spherical surface. Follower *2* oscillates about fixed axis *B* and carries tapered roller *3*. The elements of the conical surface of roller *1* intersect at centre *B*. Thus roller *3* has line contact with cam surface *a*.

3055	THREE-LINK SPATIAL CYLINDER CAM MECHANISM WITH VARIABLE FOLLOWER MOTION	SmC 3L



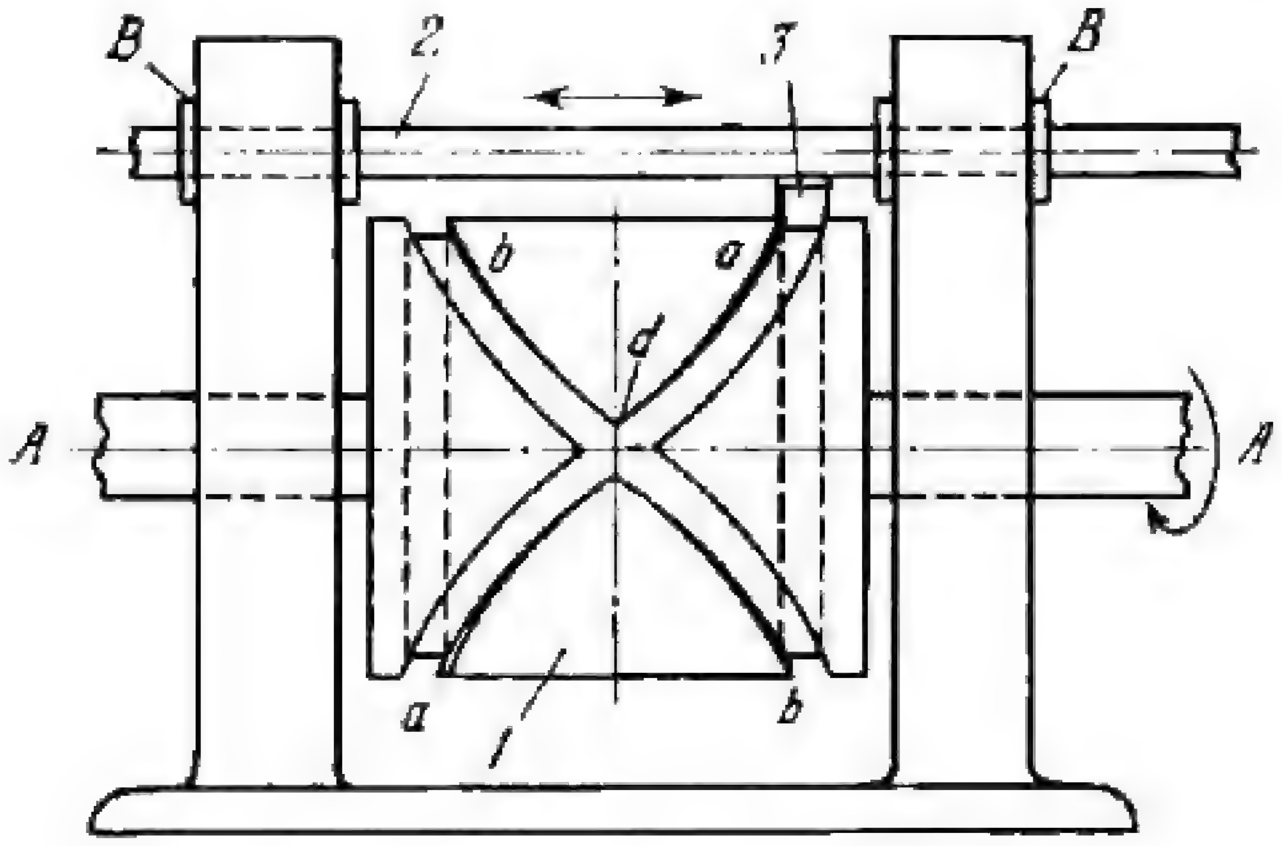
Cylinder cam *1* rotates about fixed axis *A-A* and has helical groove *a* of variable pitch, consisting of five turns. Follower *2* reciprocates in fixed guides *B-B* and carries tapered roller *3* which rolls and slides along groove *a*. One cycle of motion corresponds to five revolutions of cam *1*.

3056	THREE-LINK SPATIAL HYPERBOLOID CAM MECHANISM	SmC 3L



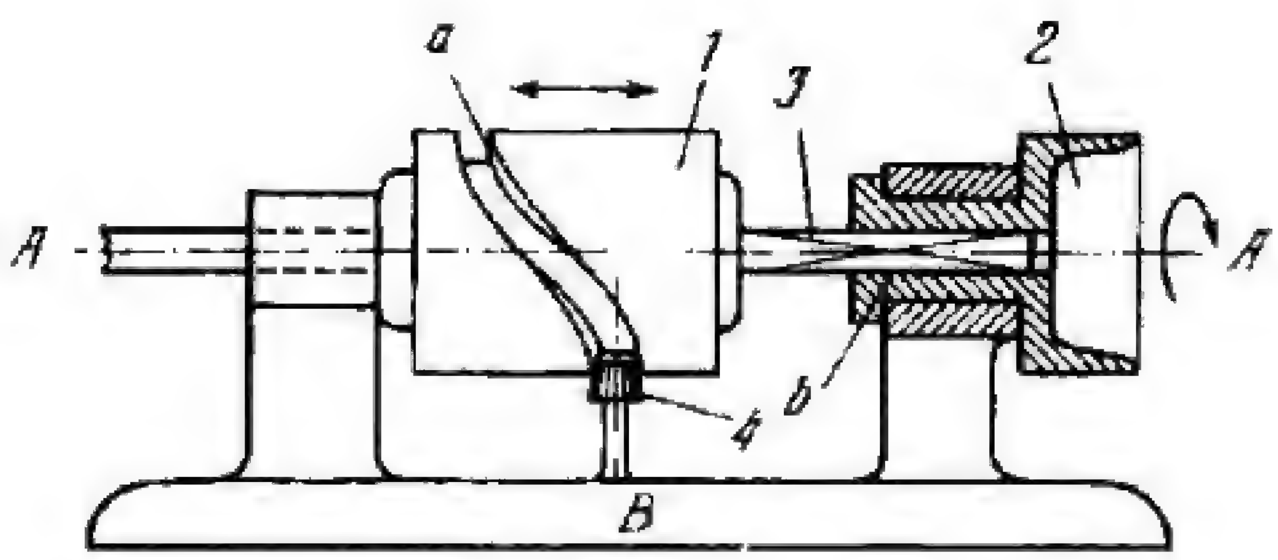
Cam *1* rotates about fixed axis *A-A* and its hyperboloid surface, in which cam groove *a* is machined, is generated by the revolution of arc *b-b* of a hyperbola about axis *A-A*. Follower *2* reciprocates in fixed guides *B-B* and carries roller *3* which rolls and slides along groove *a*. Axis *C-C* of follower motion is parallel to an element of the hyperboloid.

3057	THREE-LINK SPATIAL CROSS-GROOVED CYLINDER CAM MECHANISM WITH LONG FOLLOWER DWELLS	SmC 3L



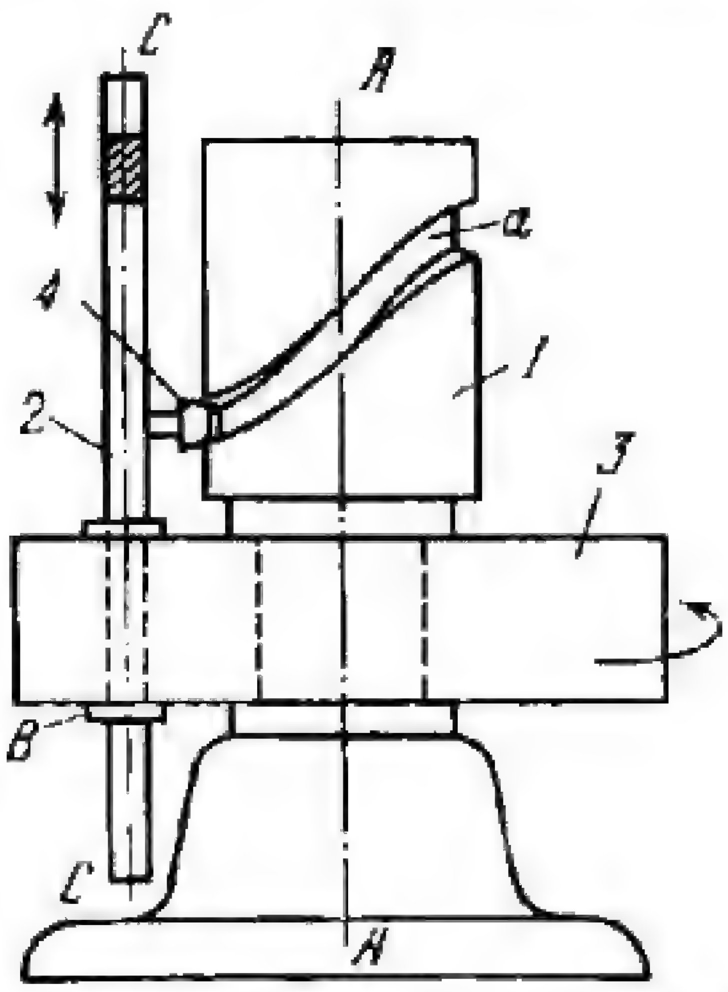
Cylinder cam *1* rotates about fixed axis *A-A* and the theoretical, or pitch, curve of its groove *aabb* has point *d* of self-intersection. Follower *2* reciprocates in fixed guides *B-B* and carries roller *3* which rolls and slides along groove *aabb*. As roller *3* passes along portions *aa* and *bb* of the groove, follower *2* travels to the right and to the left. As it passes along portions *ab* and *ba*, follower *2* has long dwells corresponding to an angle φ of cam rotation equal to 180°. A full cycle corresponds to two revolutions of cam *1*. The axis of follower motion is parallel to axis *A-A*.

3058	THREE-LINK SPATIAL INVERSE CYLINDER CAM MECHANISM WITH HELICAL CAM MOTION	SmC 3L



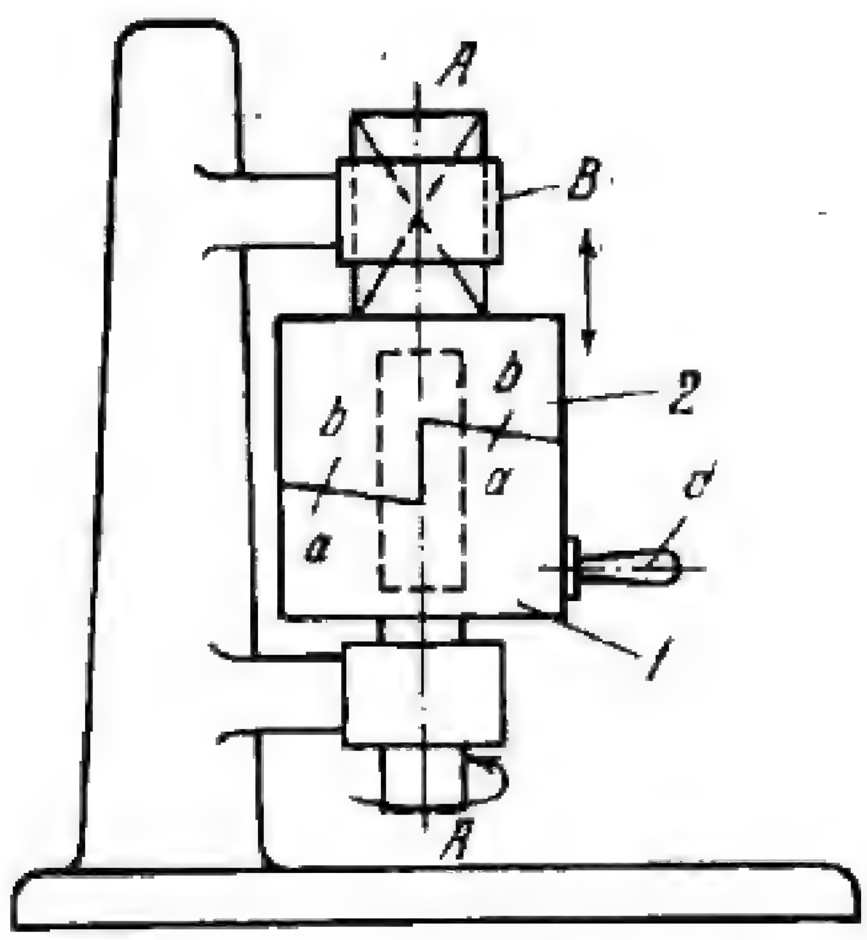
Cylinder cam *1* has helical groove *a*. Square shank *3* of cam *1* is connected by a sliding pair to link *2* which rotates about fixed axis *A-A*. Tapered roller *4* rotates freely about fixed axis *B* and rolls and slides along groove *a*. When link *2* rotates, cam *1* rotates about axis *A-A* and reciprocates along this axis. Thus, cam *1* has a helical motion which depends upon the shape of groove *a*.

3059	**THREE-LINK SPATIAL FIXED CYLINDER CAM MECHANISM**	SmC 3L



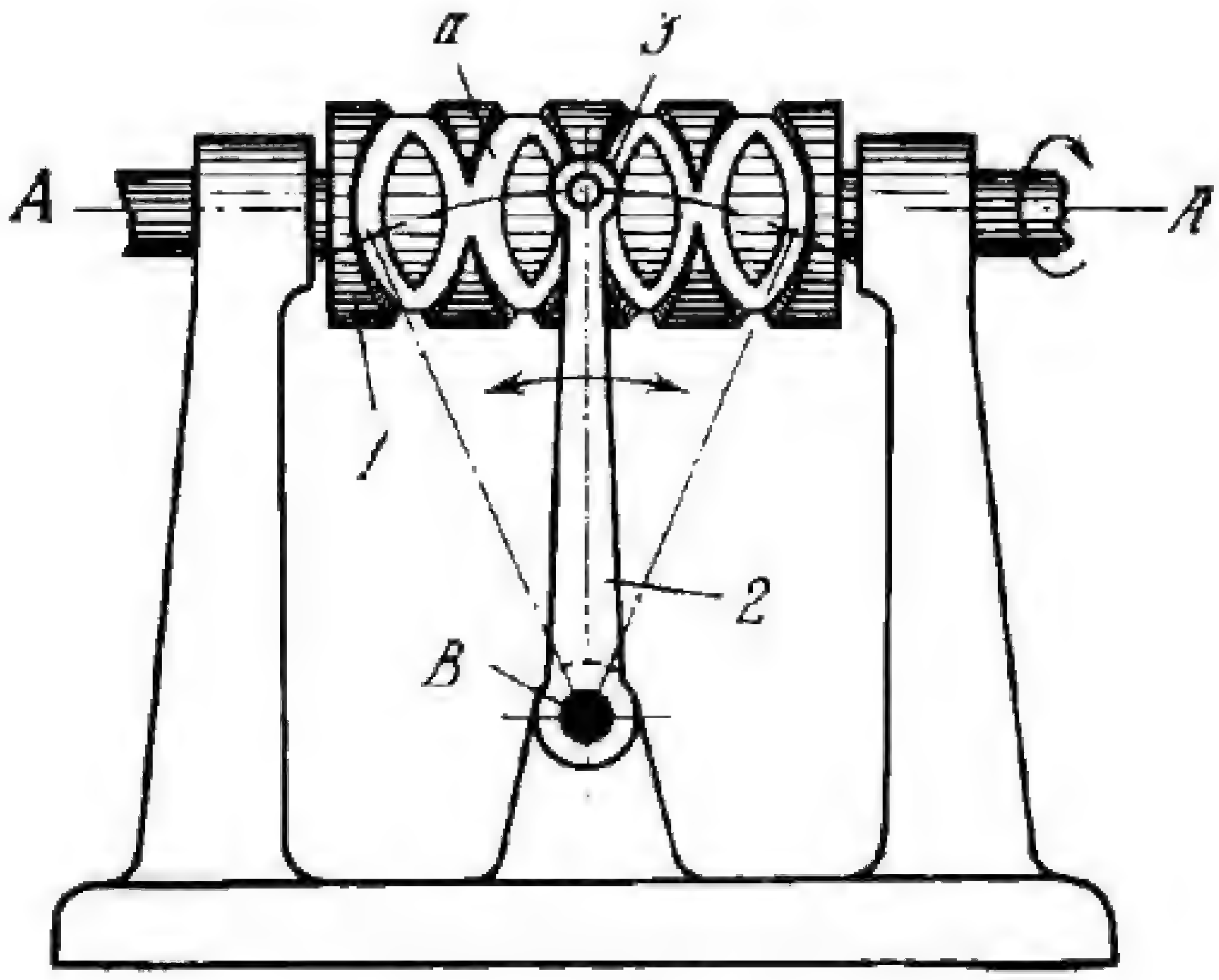
Cylinder cam *1* is fixed and has groove *a*. Follower *2* carries tapered roller *4* which rolls and slides along groove *a*. Follower *2* freely reciprocates in guide *B* of collar *3* which rotates about axis *A-A*. When collar *3* rotates, follower *2* has a complex motion consisting of rotation about axis *A-A* and reciprocation along rotating axis *C-C*.

3060	**THREE-LINK SPATIAL CAM MECHANISM**	SmC 3L



Spatial cam *1* turns about fixed axis *A-A* and has helical cam surface *a* on its face. Follower *2* reciprocates in fixed guide *B* and has on its lower face cam surface *b* which coincides with surface *a*. By turning cam *1* with handle *d*, follower *2* can be raised or lowered along axis *A-A*.

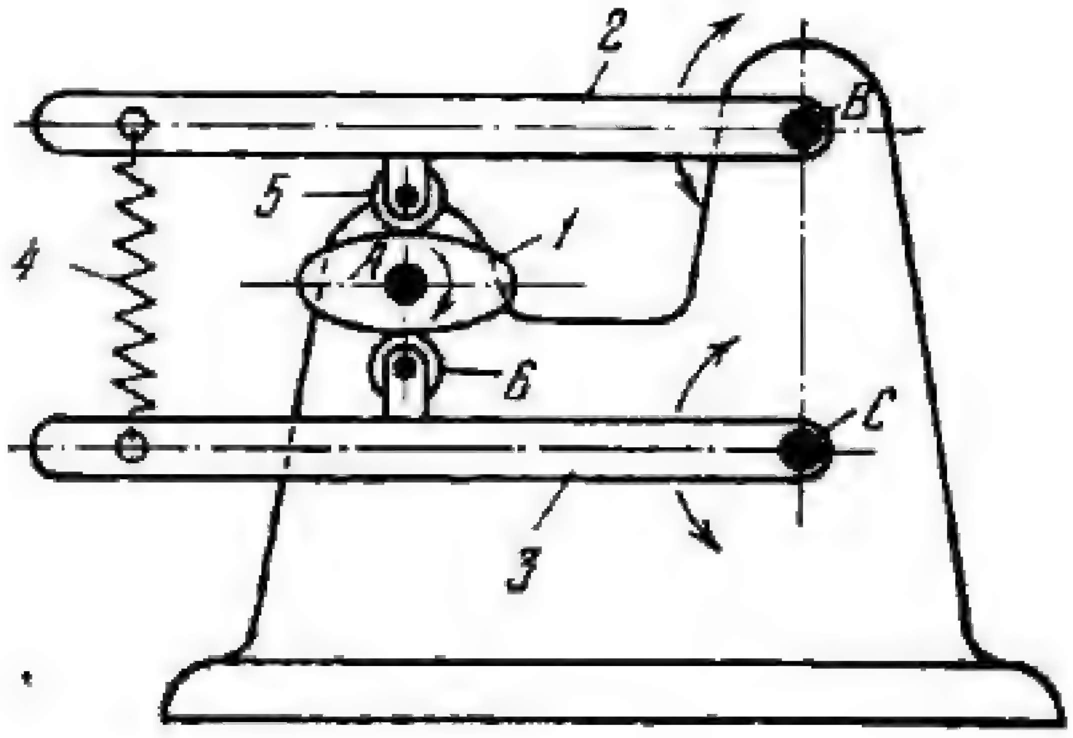
3061	THREE-LINK SPATIAL CROSS-GROOVED CYLINDER CAM MECHANISM	SmC 3L



Cylinder cam *1* rotates about fixed axis *A-A* and has helical groove *a* with right- and left-hand portions of constant pitch. Follower *2* oscillates about fixed axis *B* and carries pin *3* which slides along groove *a*. When cam *1* rotates at constant speed, follower *2* oscillates at constant angular velocity. At its extreme positions, follower *2* is automatically reversed, being switched over from right- to left-hand portions of the groove or vice versa. This provides for continuous motion of follower *2*. Axis *B* of follower oscillation is perpendicular to, but does not intersect, axis *A-A*. The plane of follower oscillation is parallel to axis *A-A*.

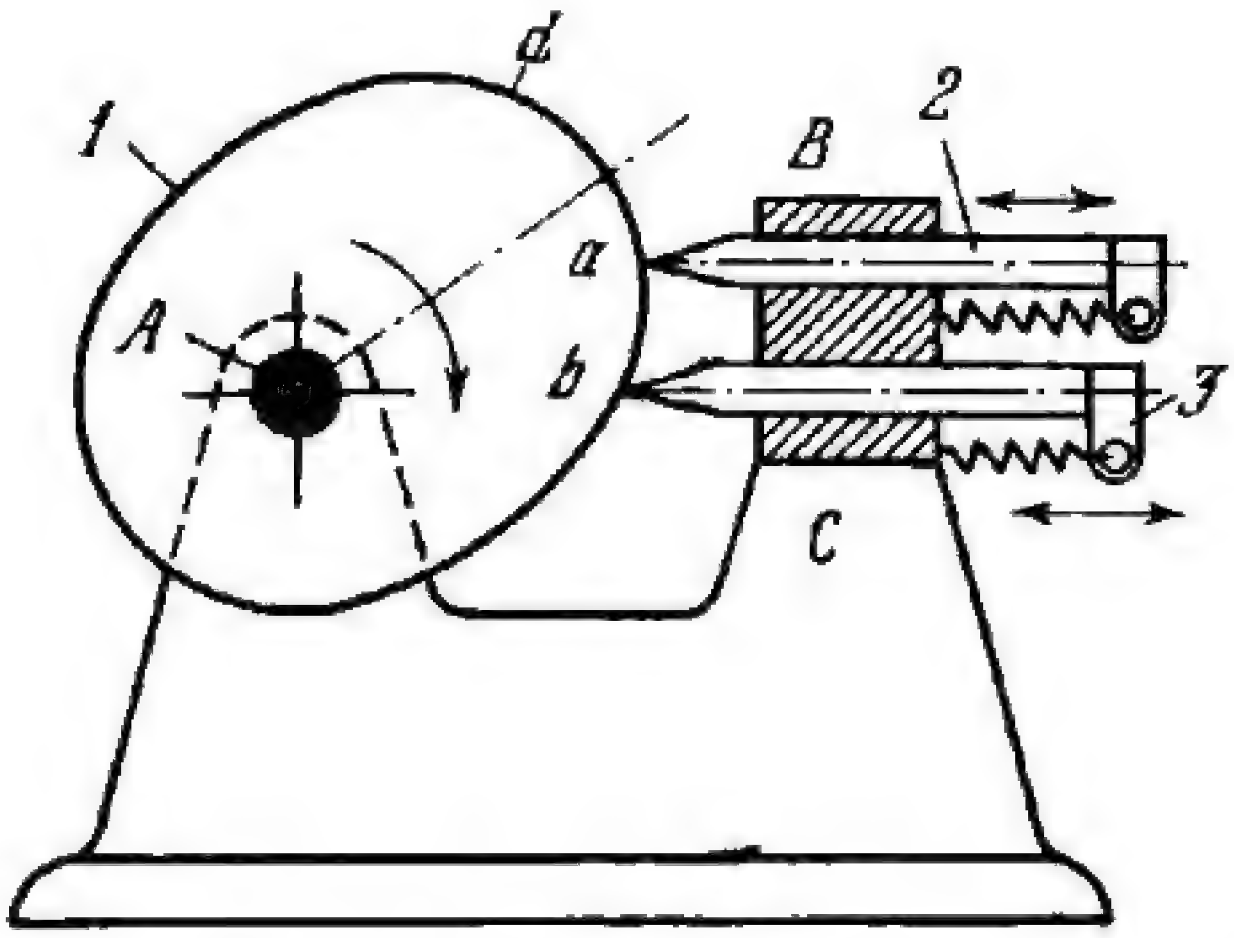
2. GENERAL-PURPOSE FOUR-LINK MECHANISMS
(3062 through 3069)

3062	FOUR-LINK DOUBLE-FOLLOWER PLATE CAM MECHANISM	SmC 4L



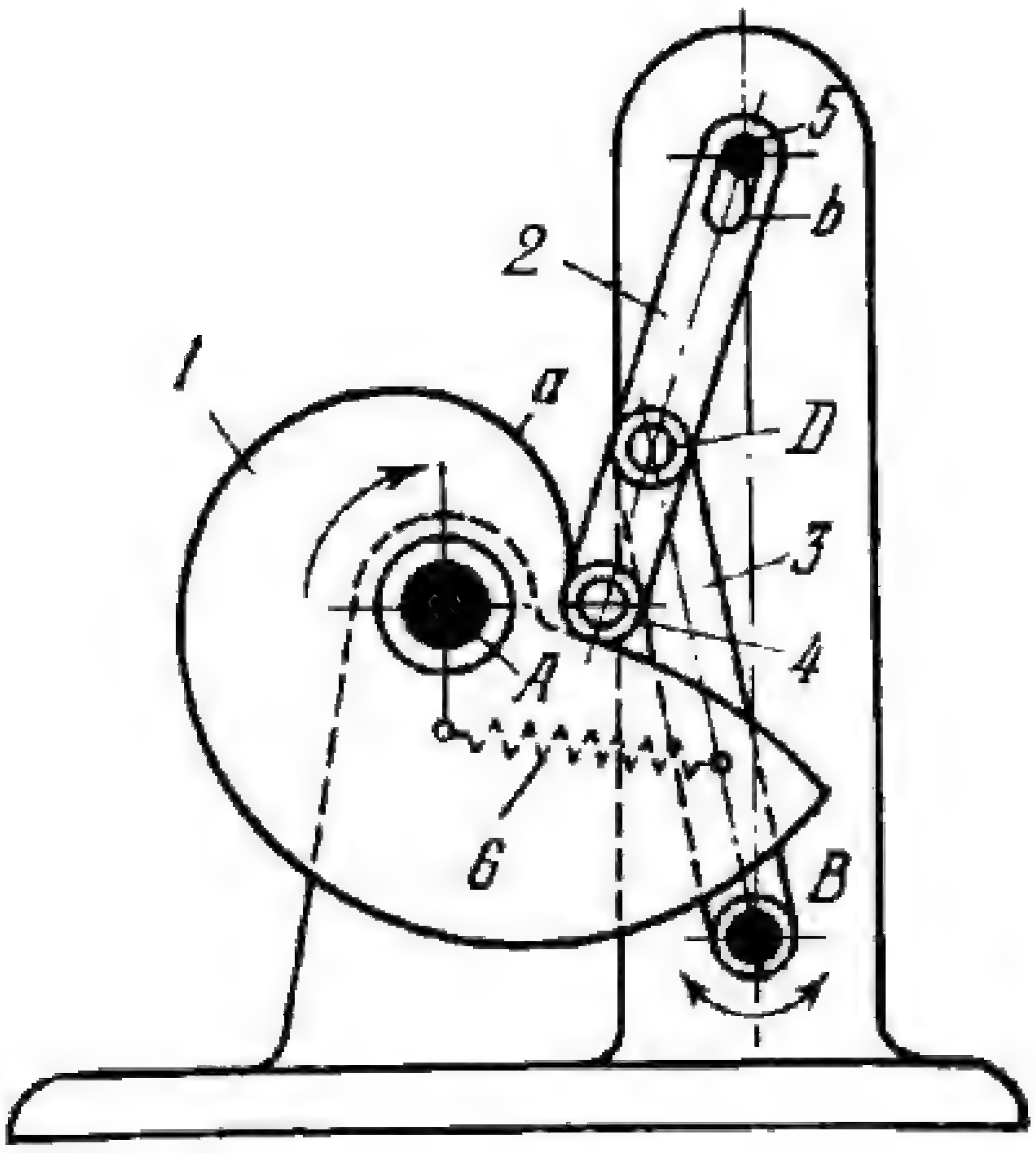
Cam *1* rotates about fixed axis *A* and its contour is along an ellipse. Two symmetrically located followers, *2* and *3*, oscillate about fixed axes *B* and *C*, and carry rollers *5* and *6* which roll along the cam surface. Followers *2* and *3* are connected by spring *4* which holds rollers *5* and *6* in contact with cam *1*. Owing to the elliptical contour of cam *1*, followers *2* and *3* have the same type of motion but displaced by a phase angle of 180°.

3063	FOUR-LINK DOUBLE-FOLLOWER PLATE CAM MECHANISM	SmC 4L



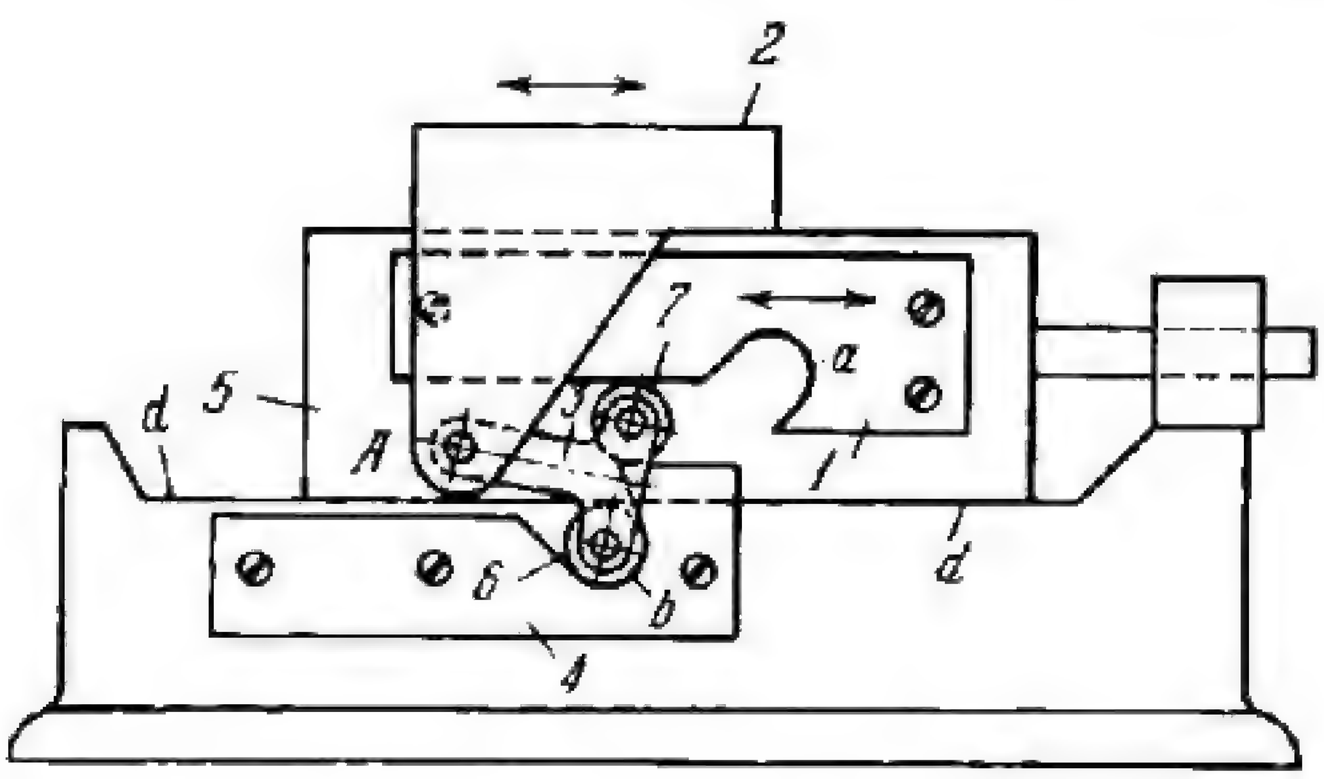
Cam *1* rotates about fixed axis *A*. Followers *2* and *3* reciprocate in fixed guides *B* and *C*, and their knife-edges *a* and *b* contact cam surface *d*. Followers *2* and *3* travel with a certain phase displacement and with different types of motion.

3064	FOUR-LINK PLATE CAM MECHANISM WITH INTERMEDIATE CONNECTING ROD AND SECONDARY FOLLOWER	SmC 4L



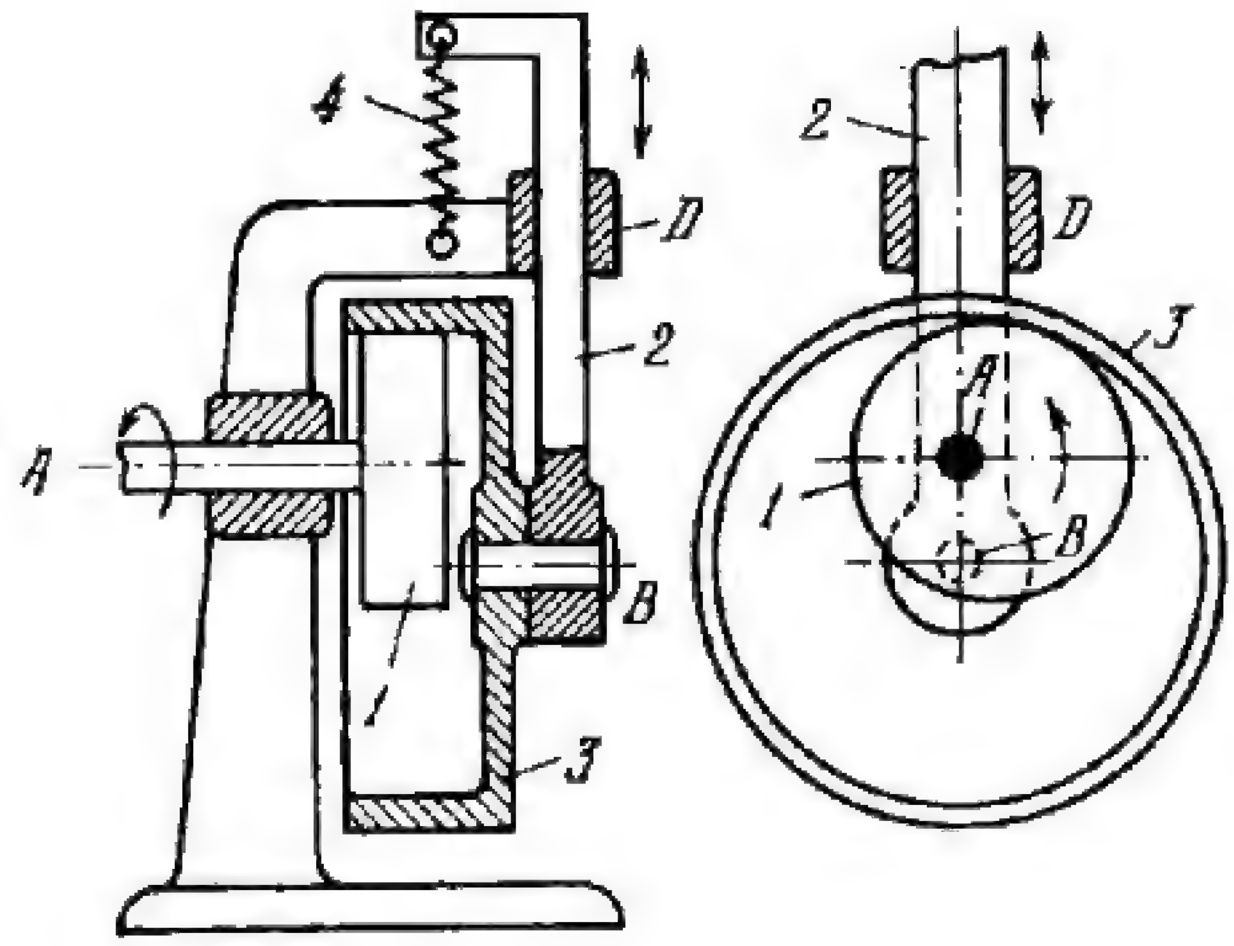
Cam *1* rotates about fixed axis *A* and has profiled contour *a*. Connecting rod (follower) *2* has slot *b* which slides along fixed pin *5*. Connecting rod *2* carries roller *4* which rolls along cam surface *a*. Secondary follower *3* oscillates about fixed axis *B* and is connected by turning pair *D* to connecting rod *2*. Cam *1* can rotate only clockwise, otherwise the mechanism jams. Roller *4* is held in contact with cam *1* by spring *6*.

3065	FOUR-LINK SLIDING CAM DWELL MECHANISM	SmC 4L



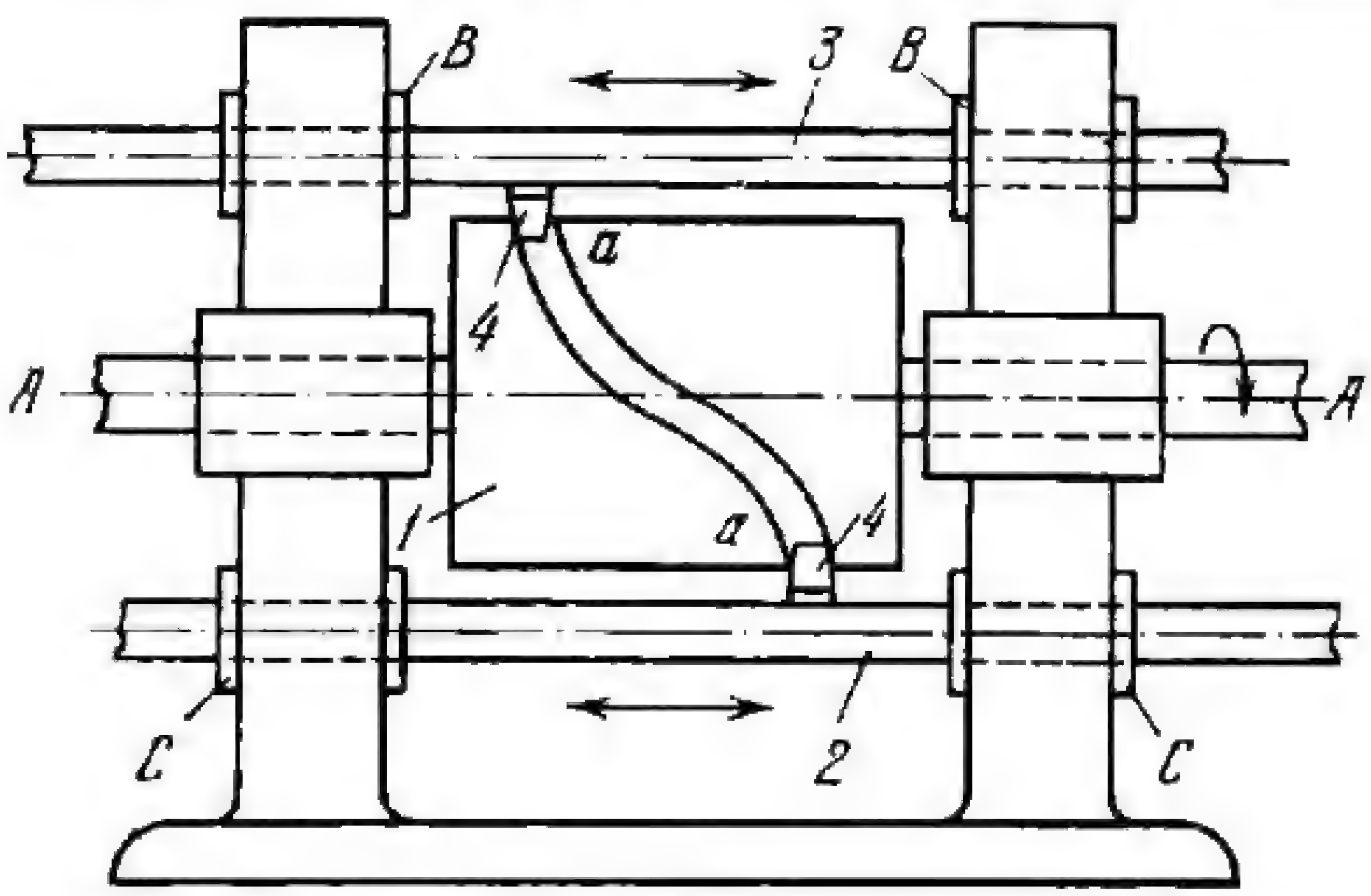
Cam *1* with recess *a* is rigidly attached to slider *5* which reciprocates along fixed guides *d-d*. Link (follower) *2* slides along slider *5* and is connected by turning pair *A* to latch *3* which carries two rollers, *6* and *7*. Fixed cam *4* has recess *b*. When slider *5* travels to the left, recess *a* catches roller *7*, turning latch *3* counterclockwise about axis *A*, and follower *2* also travels to the left with slider *5*. When slider *5* travels to the right, roller *6* drops into recess *b*, turning latch *3* clockwise and retracting roller *7* from recess *a*, so that follower *2* has a dwell.

3066	FOUR-LINK ECCENTRIC CAM MECHANISM	SmC 4L



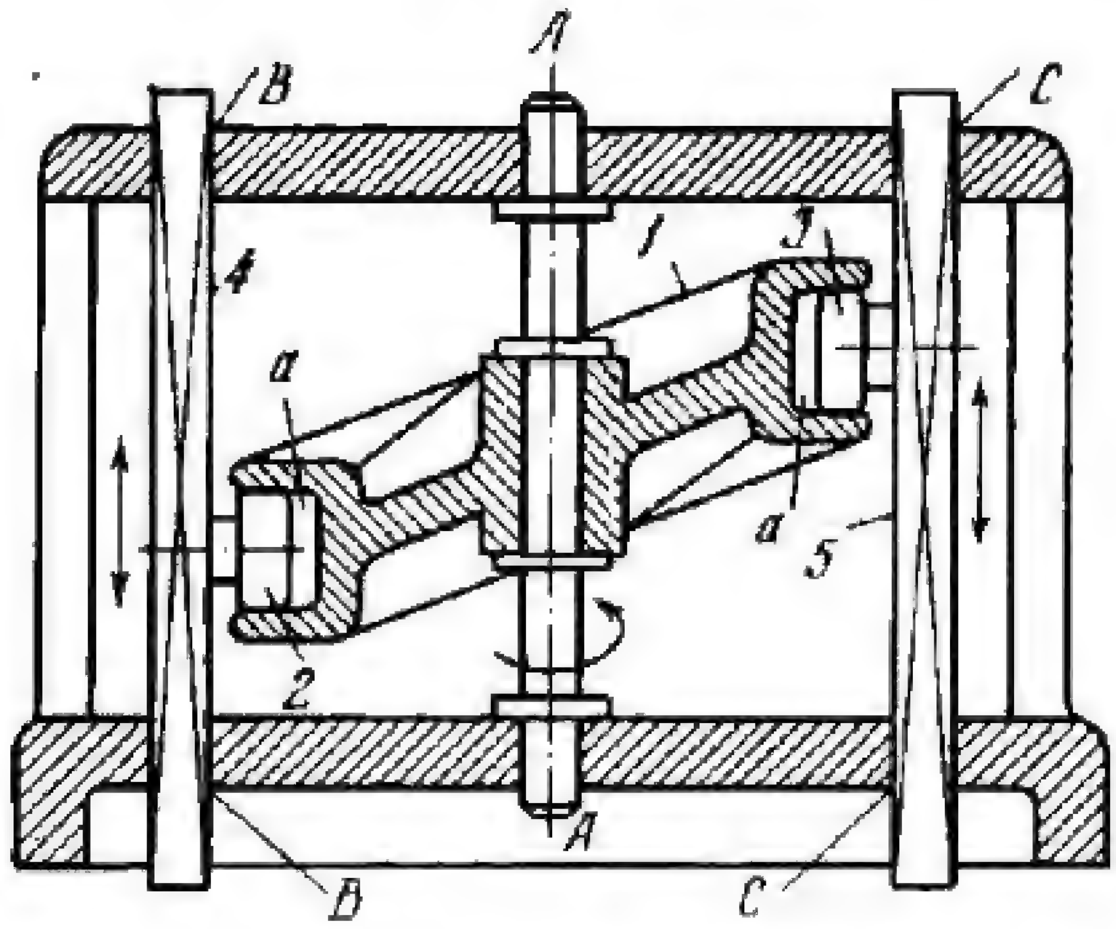
Round eccentric cam *1* rotates about fixed axis *A*. Follower *2* reciprocates in fixed guide *D* and is connected by turning pair *B* to roller *3* which has an annular rim whose inner surface contacts the contour of cam *1*. Roller *3* is held in contact with cam *1* by spring *4*.

3067	FOUR-LINK SPATIAL DOUBLE-SLIDING-FOLLOWER CYLINDER CAM MECHANISM	SmC 4L



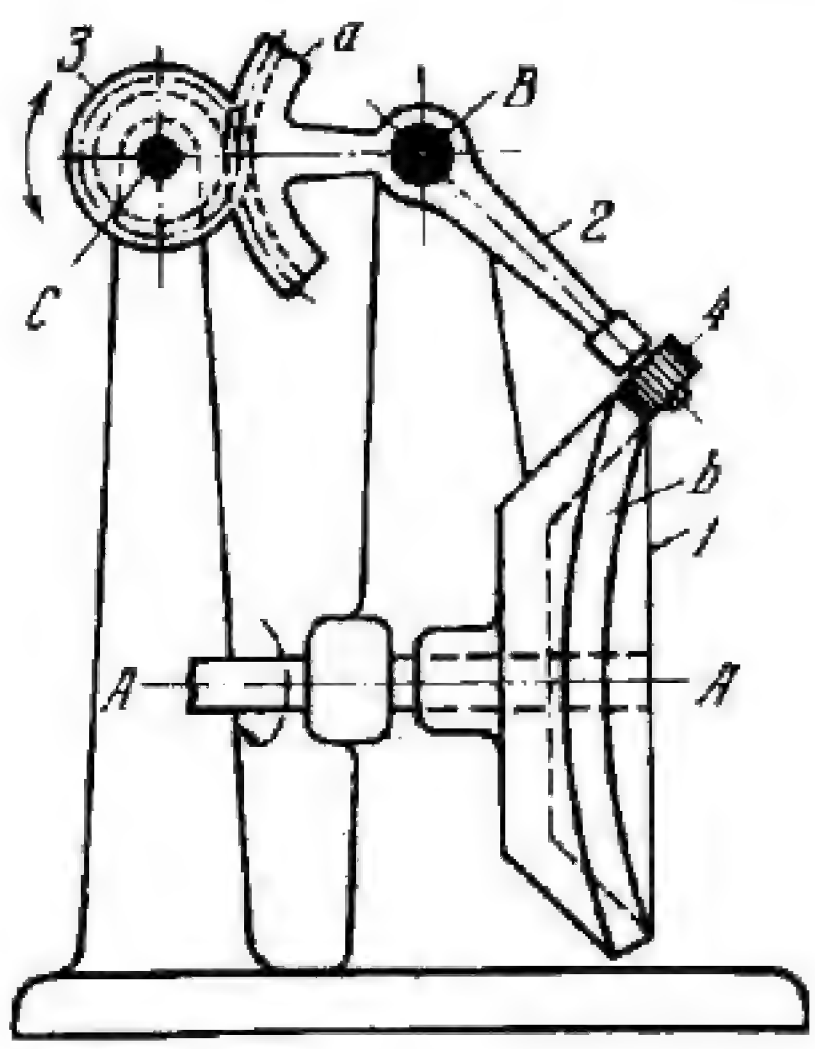
Cylinder cam *1* rotates about fixed axis *A-A* and has profiled cam groove *a-a*. Followers *2* and *3* reciprocate in fixed guides *C-C* and *B-B*, and carry tapered rollers *4* which roll and slide along groove *a-a*. Owing to the symmetrical location of followers *2* and *3*, whose axes of motion are parallel to axis *A-A*, the followers have the same type of motion, but displaced by a phase angle of 180°.

3068 FOUR-LINK SPATIAL DOUBLE-SLIDING-FOLLOWER CYLINDER CAM MECHANISM — SmC 4L



Cylinder cam *1* rotates about fixed axis *A-A* and has profiled groove ***a***. Followers *4* and *5* reciprocate in fixed guides *B-B* and *C-C*, and carry rollers *2* and *3* which roll and slide along groove *a*. The axes of guides *B-B* and *C-C* are parallel to axis *A-A*. Thus followers *4* and *5* are raised and lowered simultaneously (one being raised and the other lowered), their motions being displaced by a phase angle corresponding to a half-revolution of cam *1*.

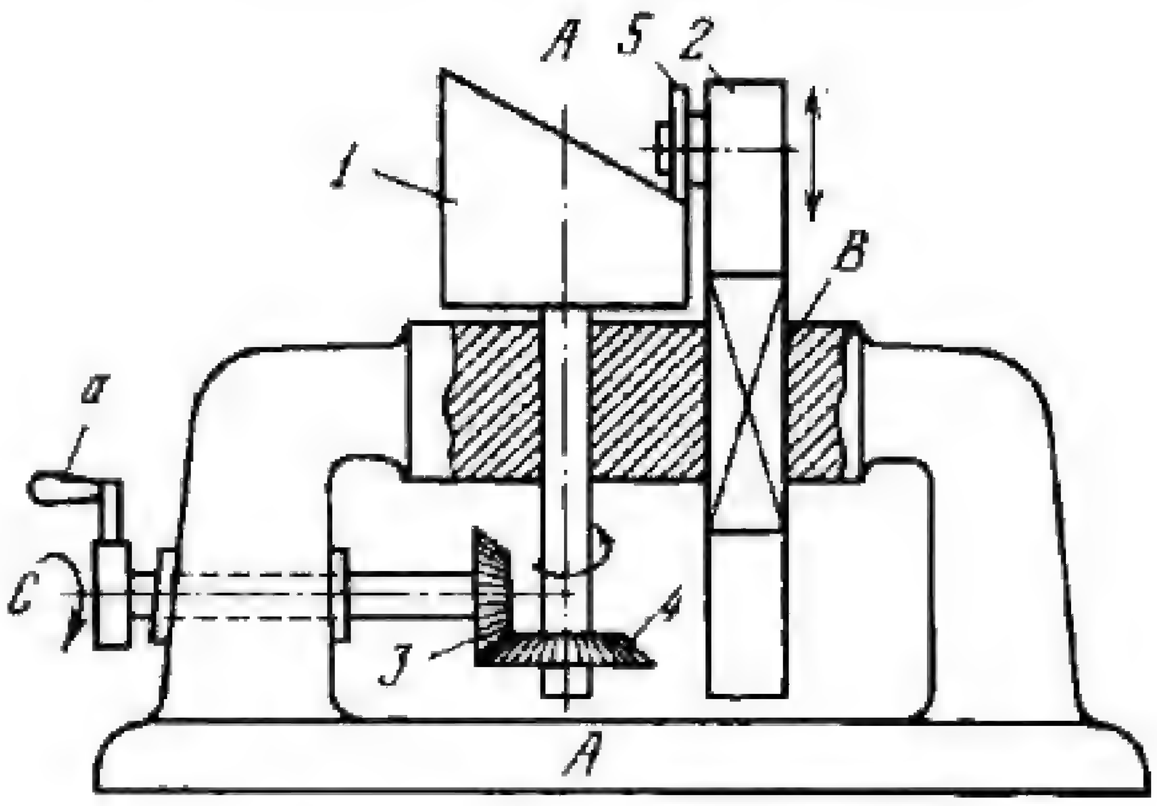
3069 FOUR-LINK SPATIAL SPHERICAL CAM MECHANISM WITH GEAR SEGMENT AND GEAR — SmC 4L



Spherical cam *1* rotates about fixed axis *A-A* and has cam surface *b*. Follower *2* oscillates about fixed axis *B* and carries roller *4* which rolls along cam surface *b*. Rigidly attached to follower *2* is gear segment *a*, meshing with gear *3* which oscillates about fixed axis *C*. When cam *1* rotates, gear *3* oscillates about axis *C*.

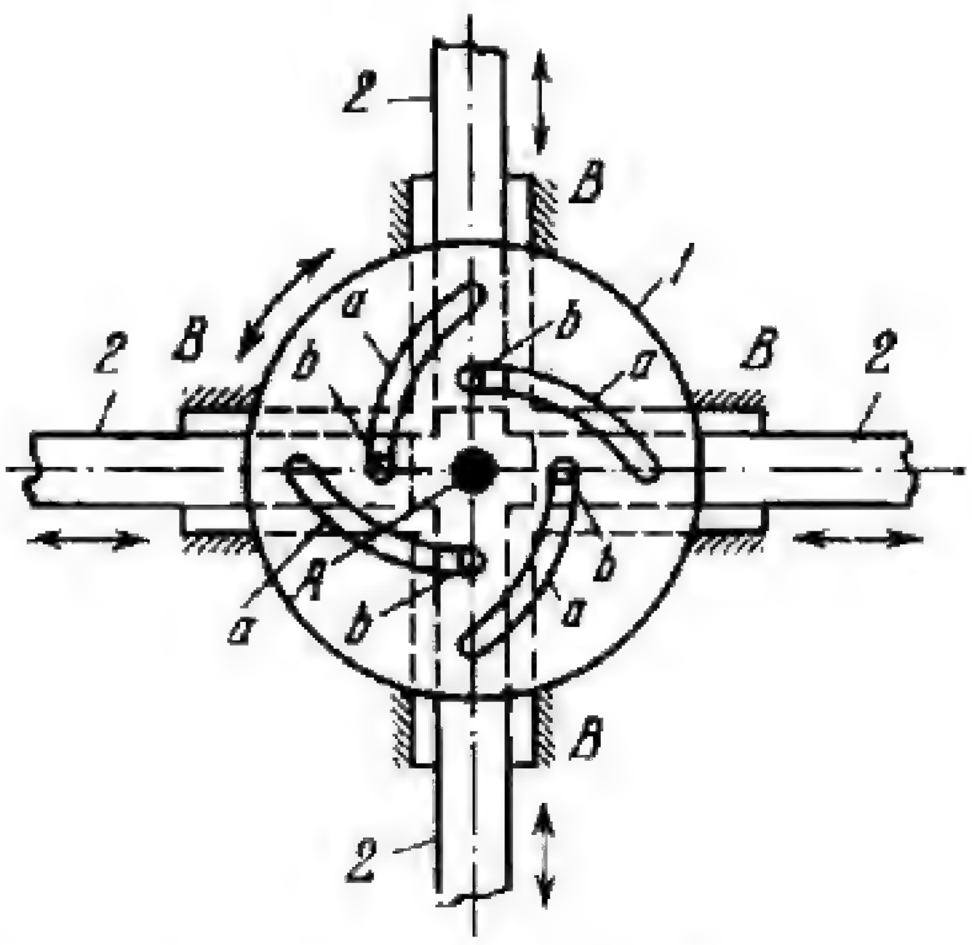
3. GENERAL-PURPOSE MULTIPLE-LINK MECHANISMS (3070 through 3099)

3070	GEAR-DRIVE SPATIAL SIDE CAM MECHANISM	SmC ML



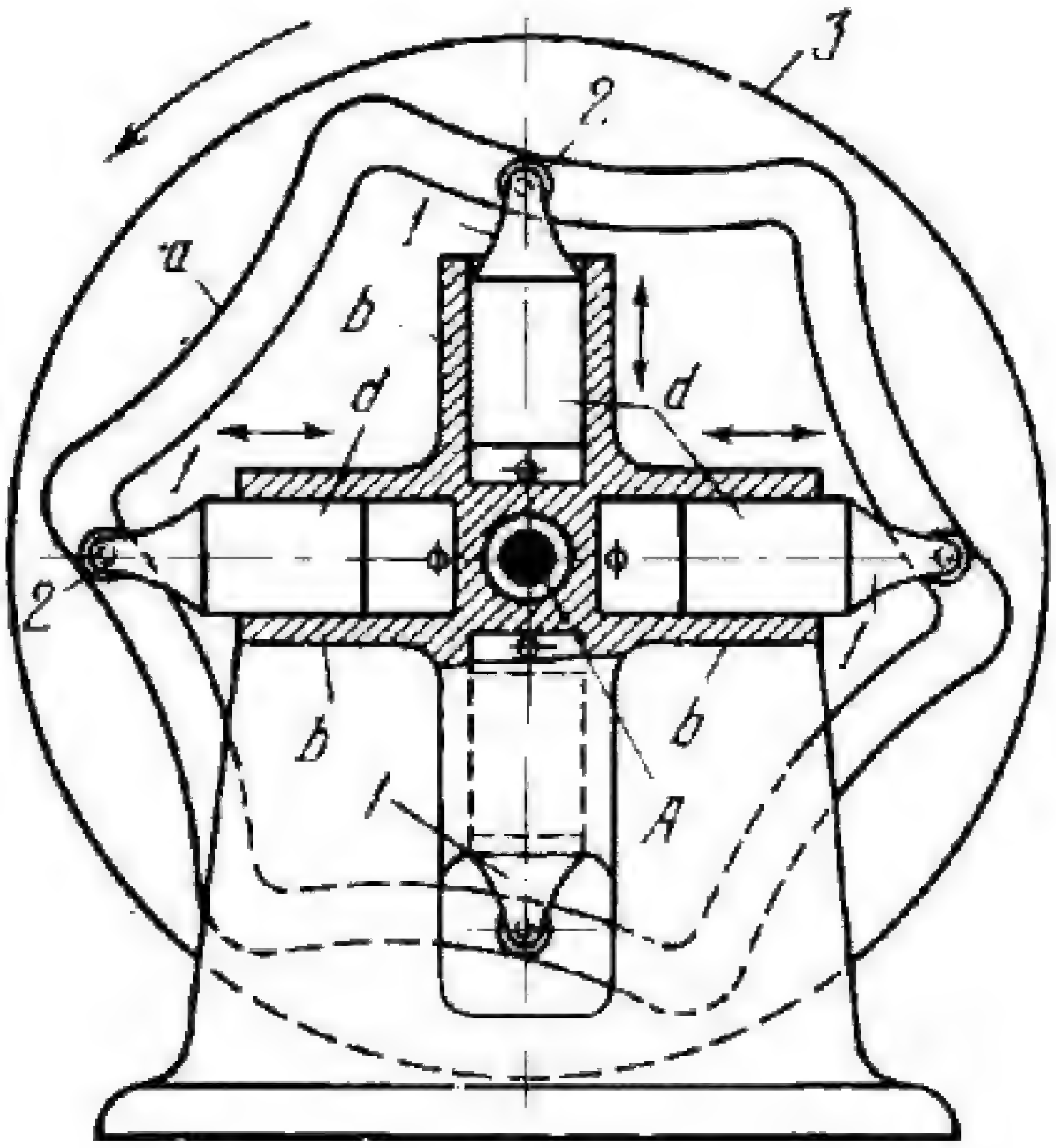
Side cam *1* is a truncated cylinder and rotates about axis *A-A*. Follower *2* reciprocates in fixed guide *B* and carries roller *5* which rolls along the face of cam *1*. Cam *1* is driven by hand-wheel *a*, rotating about fixed axis *C*, through bevel gears *3* and *4*.

3071	FOUR-FOLLOWER FACE CAM MECHANISM	SmC ML



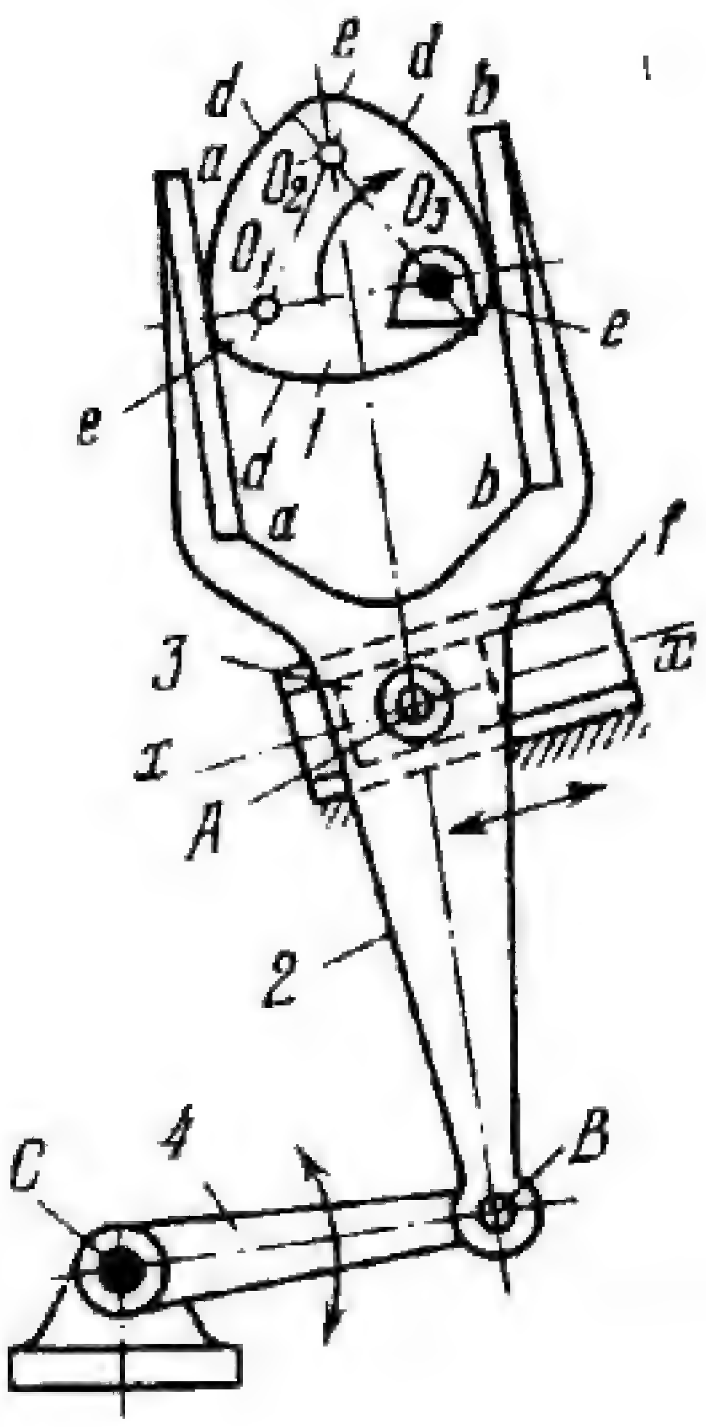
Cam *1* turns about fixed axis *A* and has four profiled grooves *a*. Symmetrically located followers *2* slide in fixed guides *B* and carry pins *b* which slide along grooves *a*. When cam *1* is turned through a certain angle, followers *2* slide along their axes. Positive motion is achieved because the diameter of pins *b* equals the width of grooves *a*. The mechanism is used for indexing and locking the followers in their extreme positions.

3072	FOUR-FOLLOWER INVERSE FACE CAM MECHANISM	SmC ML



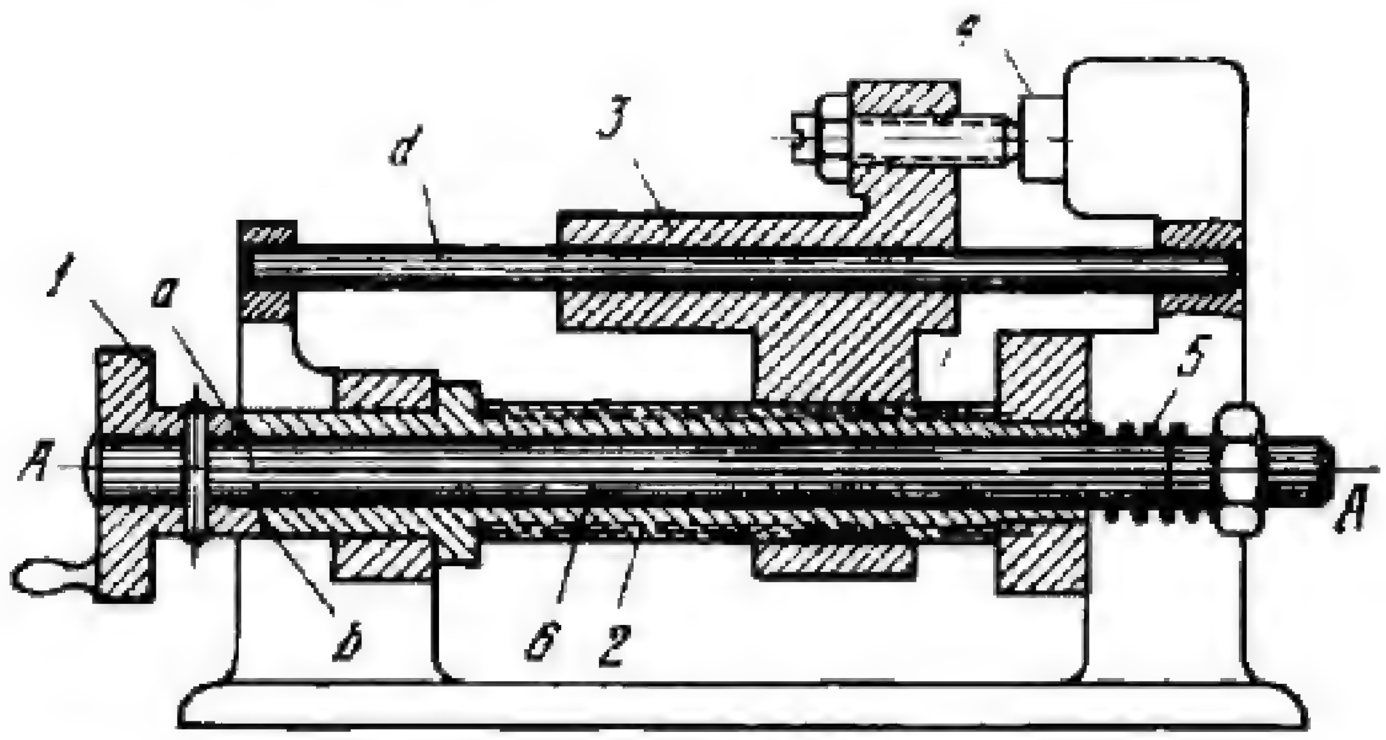
Pistons *d* of followers *1* slide in cylinders *b* and are driven by expanding gas in the cylinders. Followers *1* carry rollers *2* which roll and slide along profiled cam groove *a*, consisting of six symmetrical portions. When pistons *d* consecutively move outward, cam disk *3* with groove *a* rotates about fixed axis *A*. The sequence and cycle of motion of followers *1* are controlled by special devices which are synchronized with the process of ignition of the fuel-air mixtures in the cylinders. Positive motion is achieved because the diameter of rollers *2* equals the width of groove *a*.

3073	PLATE CAM MECHANISM WITH COMPLEX FOLLOWER MOTION	SmC ML



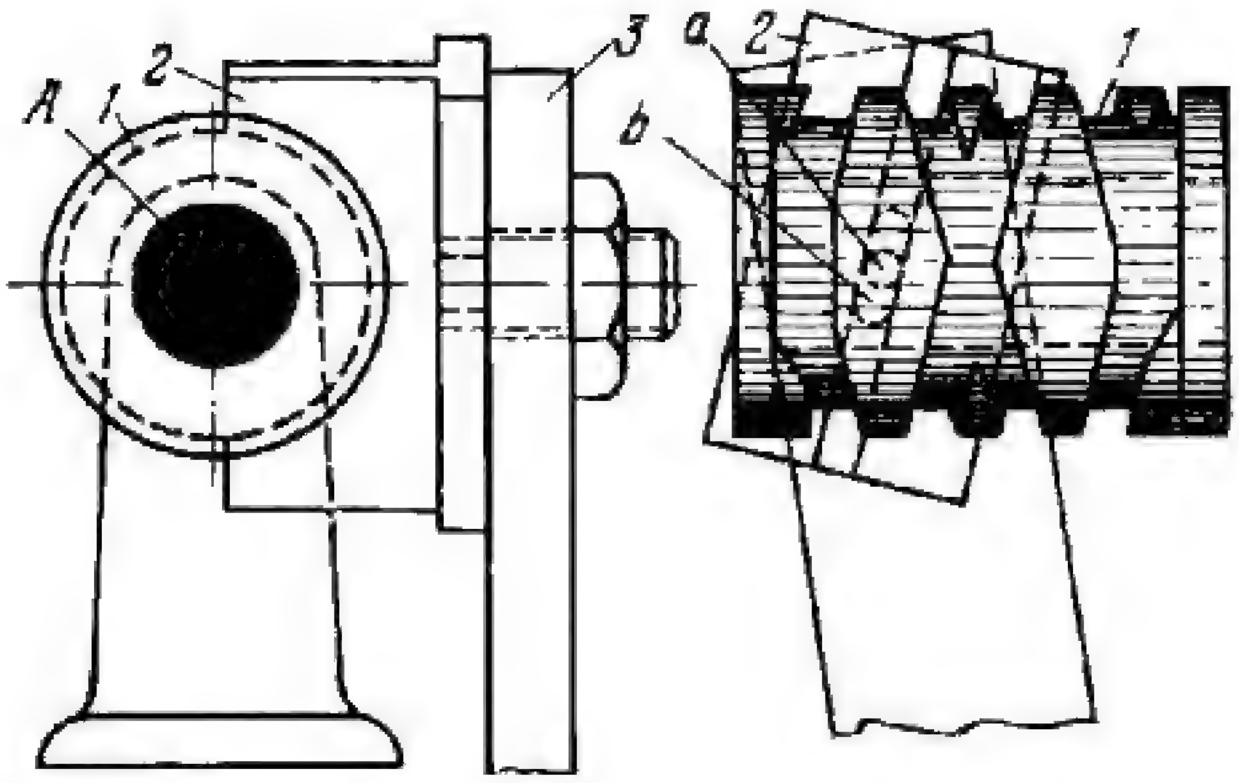
Cam *1* rotates about fixed axis O_3 and its contour is composed of six circular arcs described from centres O_1, O_2 and O_3. Large arcs *d* are tangent to small arcs *e*, described from the same centres: O_1, O_2 and O_3. Follower *2* has two parallel flat faces *a-a* and *b-b* which contact cam *1*. Follower *2* is connected by turning pairs *A* and *B* to slider *3* and lever *4*. Slider *3* reciprocates along axis *x-x* of fixed guide *f*, and lever *4* oscillates about fixed axis *C*. When cam *1* rotates, follower *2* has a complex motion with dwells when arcs *d* and *e*, described from centre O_3, are in contact with faces *a-a* and *b-b*. Positive motion is achieved because all the diameters of cam *1* are equal to the distance between faces *a-a* and *b-b*.

3074	SIDE CAM AND SCREW DISENGAGING MECHANISM	SmC ML



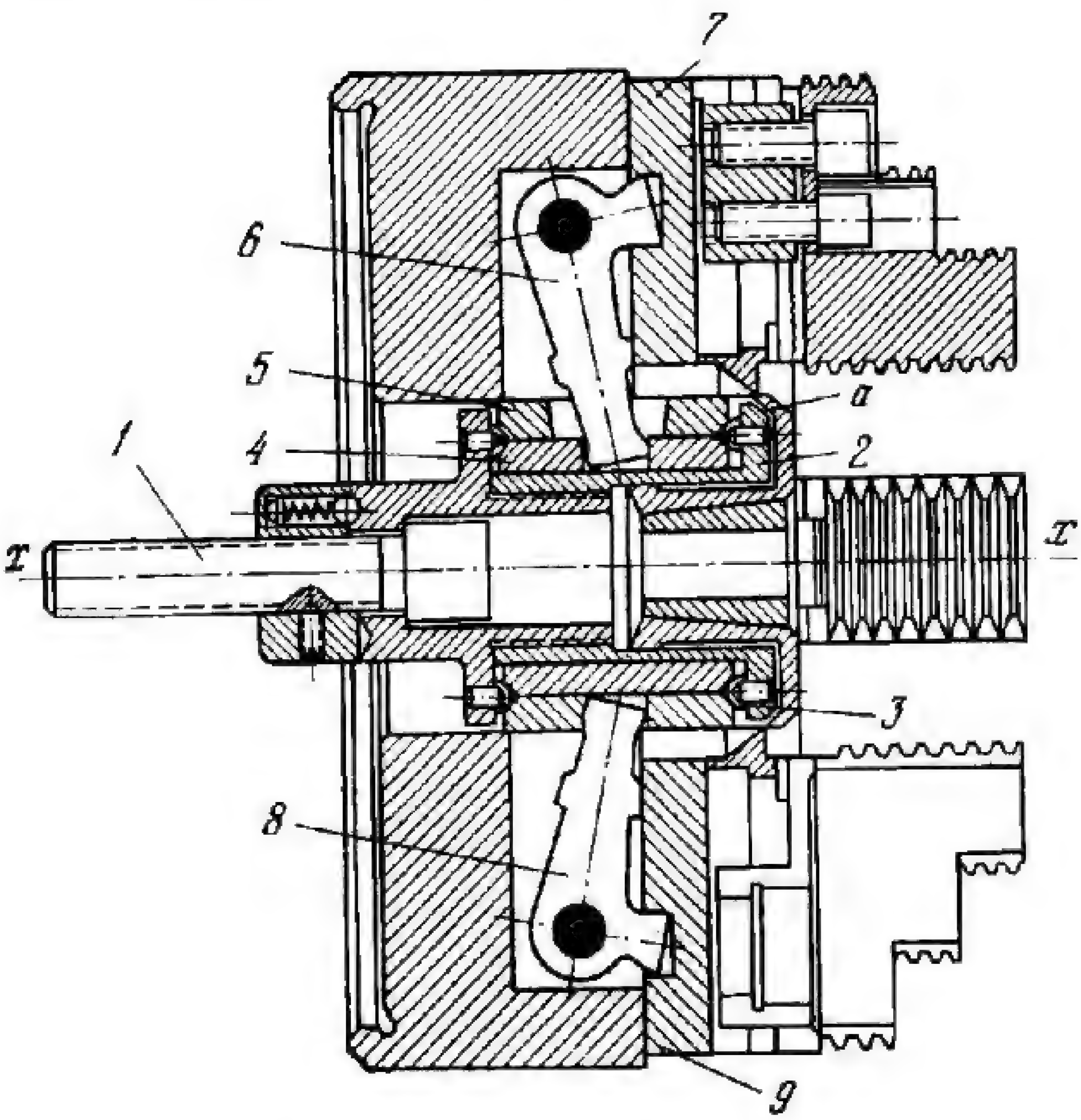
When handwheel *1* is rotated about fixed axis *A-A*, screw *2* traverses slide *3*, whose lower end is a nut, along fixed guide *d*. As soon as slide *3* runs up against stop *4*, or the mechanism is overloaded, cam surface *a* of handwheel *1*, designed as an inclined plane, begins to turn with respect to mating cam surface *b* of screw *2*. This shifts shaft *6* to the left, compressing spring *5* and screw *2* remains stationary.

3075	SPATIAL CROSS-GROOVED CYLINDER CAM MECHANISM	SmC ML



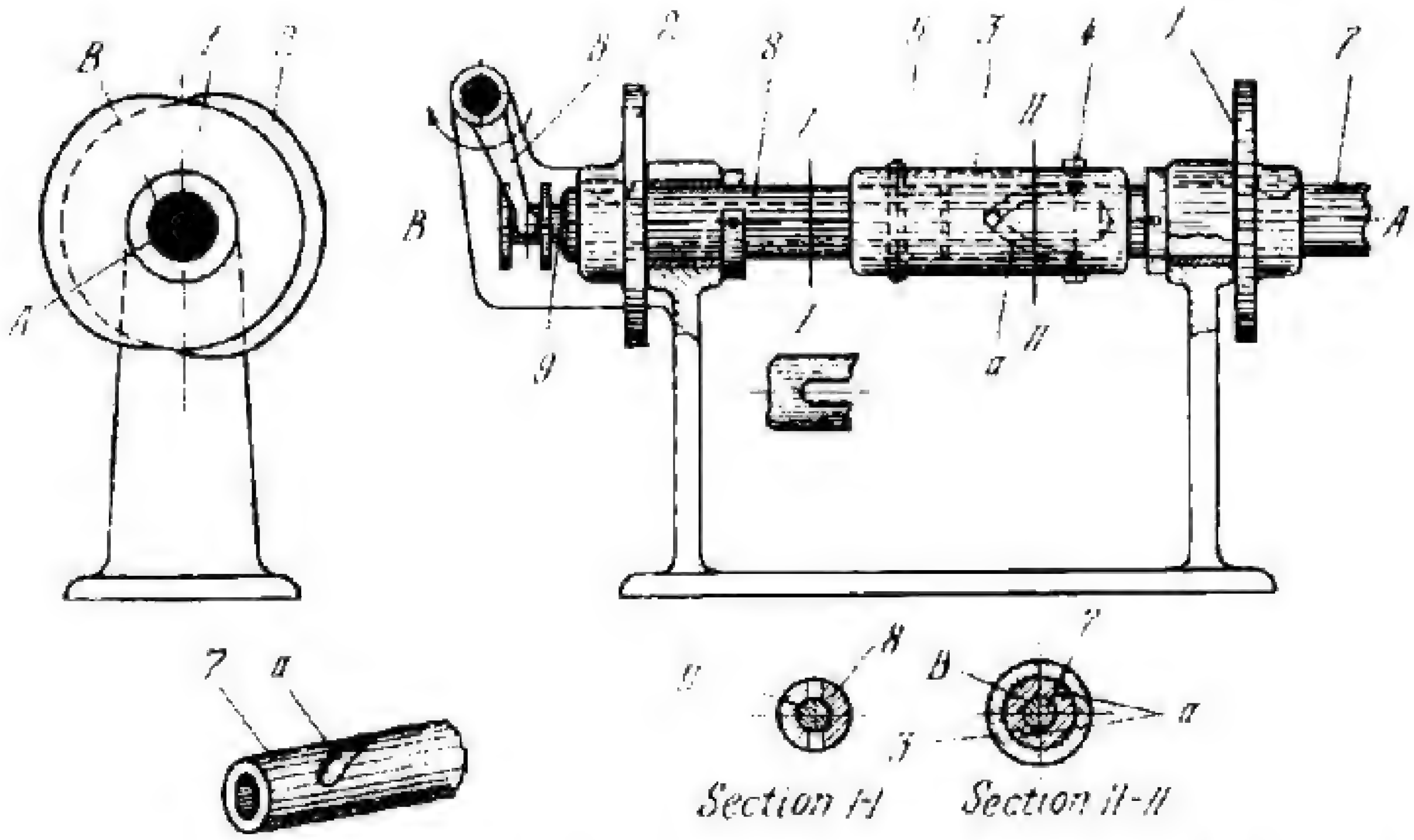
Cam *1* rotates about fixed axis *A* and has a helical groove with right- and left-hand turns. Half-nut *2*, consisting of a single ridge, engages the groove of cam *1* and travels along its axis. When it reaches an extreme position, half-nut *2* is swivelled by the end turn of the groove and its travel is reversed. Follower *3*, whose pin *a* slides along slot *b* of the half-nut, is imparted an oscillating motion with dwells at its extreme positions about an axis (not shown).

3076	AKTOV AND JÁNOSSI FOUR-JAW SELF-CENTERING CHUCK	SmC ML



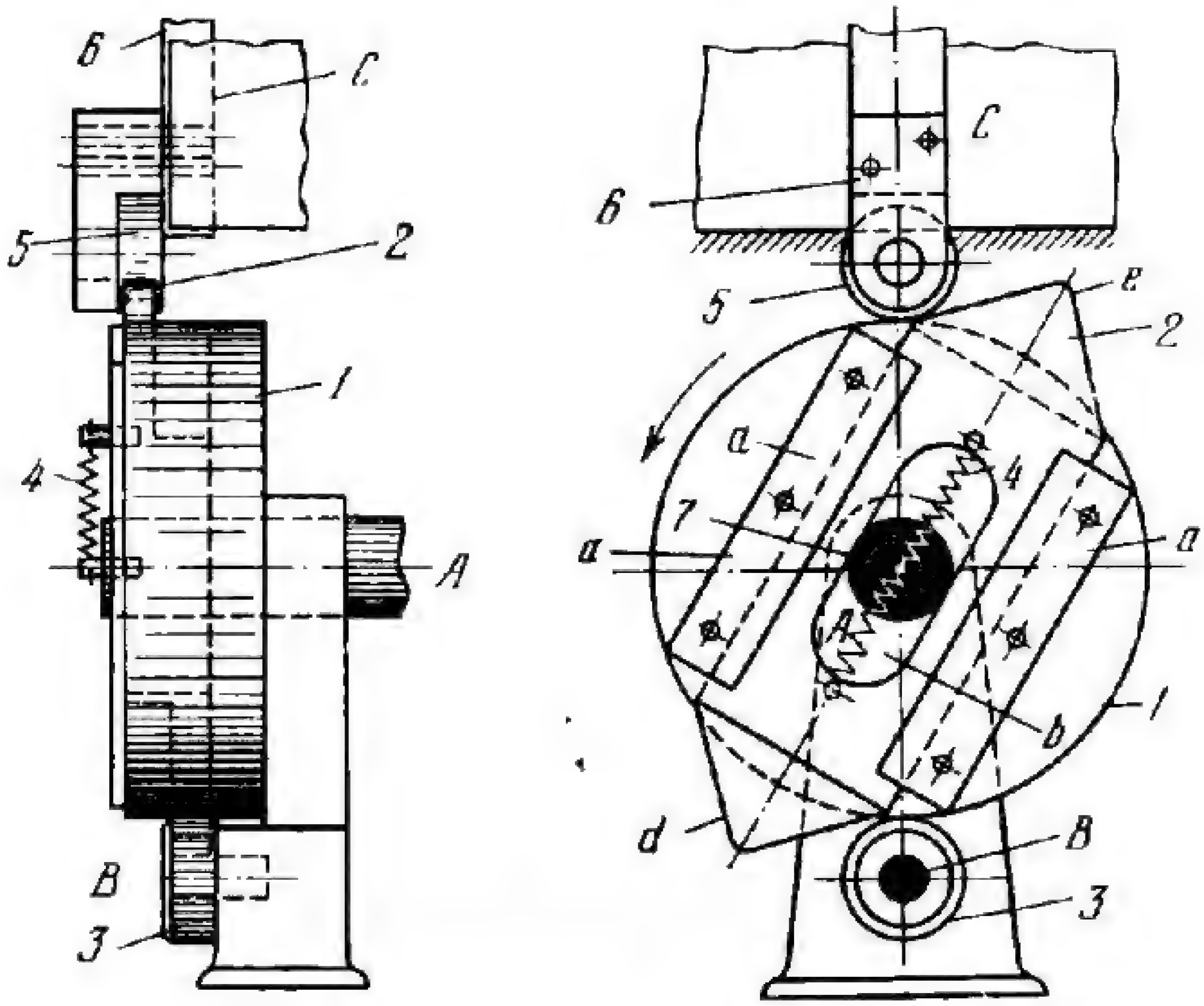
When draw-bolt *1* is pulled to the left by the chuck-operating device (not shown), it pulls sleeve *2* to the left and its shoulder *a* forces spherical equalizing members *3* against the conical surfaces of sleeves *4* and *5*. Sleeve *4* has two openings for the ends of diametrally opposed bell-crank levers *6* whose other arms engage slots in jaws *7*. Sleeve *5* has four openings, two through which levers *6* pass with a large clearance, and two for the ends of diametrally opposed bell-crank levers *8* whose other arms engage slots in jaws *9*. The drawing is a conventional section view, with its upper half being a section through one of the jaws *7* and the lower half through a jaw *9*. The two sections are actually at an angle of 90° to each other. Sleeves *4* and *5* turn the two pairs of opposing jaws, *7* and *9*, until one pair contacts and centres the workpiece. At this, the sleeve linked to this pair of jaws stops and the second sleeve continues to move to the left, owing to the radial displacement of equalizing members *3*, until the second pair of jaws also contacts the workpiece. When all four jaws contact the workpiece, it is finally clamped. The workpiece is released by reversing the motion of draw-bolt *1*.

3077	QUICK-CHANGE MECHANISM FOR ANGULAR POSITION OF CAMS	SmC ML



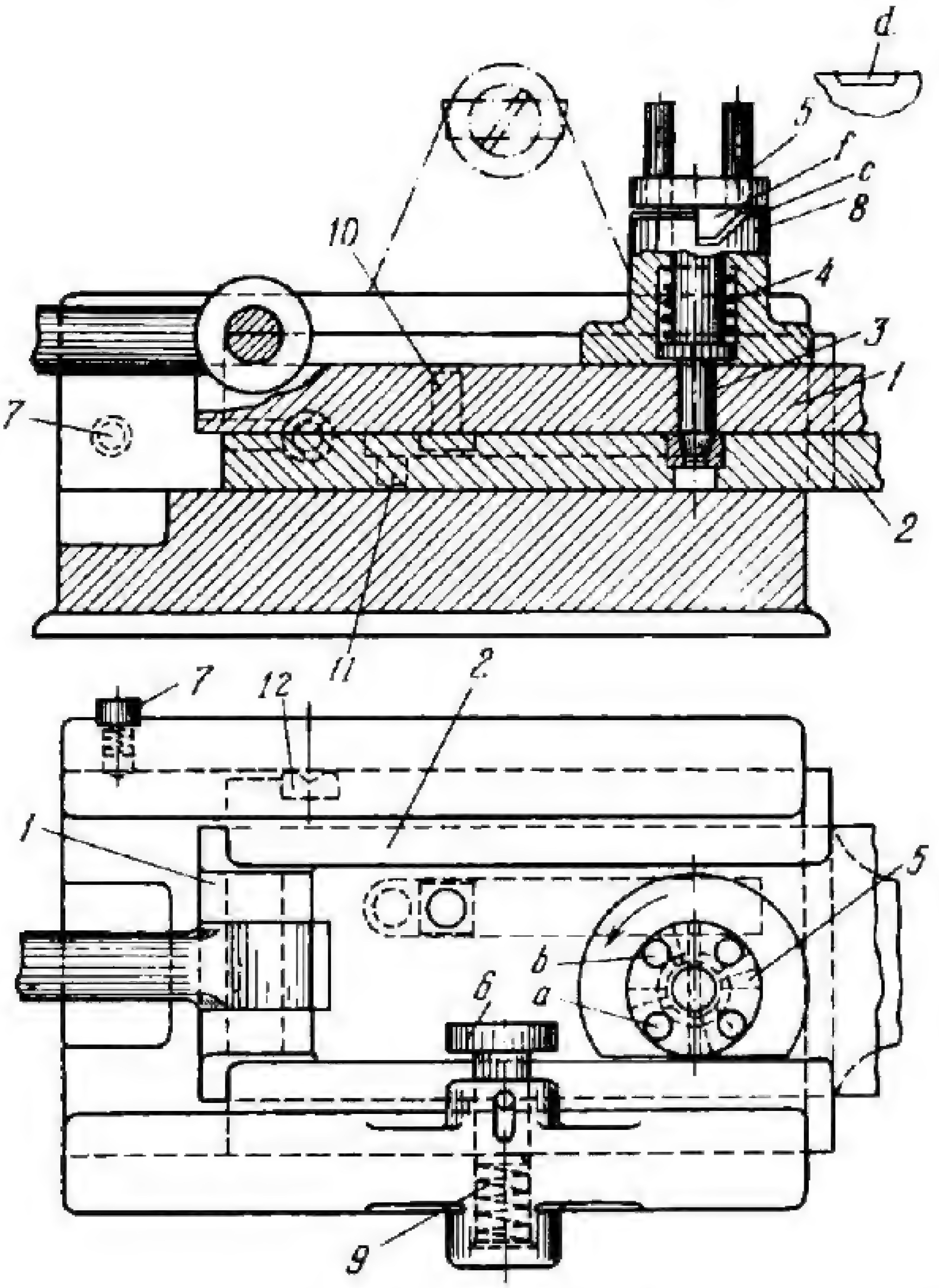
Cam *1* is keyed to shaft *7* and rotates about fixed axis *A*. Cam *2* is keyed to shaft *8* and is rotated about fixed axis *B* through sleeve *3*. Sleeve *3* is connected to shaft *7* by dog-point setscrews *4* whose tips slide along helical slots *a* in shaft *7* and to shaft *8* by pin *5* which passes through an axial slot in this shaft. Pin *5* extends through a hole in shifter shaft *9* which can slide axially inside hollow shaft *8*. To change the relative angular position of cams *1* and *2*, lever *6* is turned clockwise, pulling shifter shaft *9*, pin *5*, sleeve *3* and setscrews *4* to the left with respect to shafts *7* and *8*. The tips of setscrews *4*, operating in helical slots *a*, turn sleeve *3*, shafts *8* and *9*, and cam *2* through a certain angle with respect to cam *1*. The angle through which cam *2* is turned with respect to cam *1* depends upon the displacement of shaft *9* which, in turn, depends upon the angle of rotation of lever *6*.

3078	SLIDING-LOBE PLATE CAM MECHANISM	SmC ML



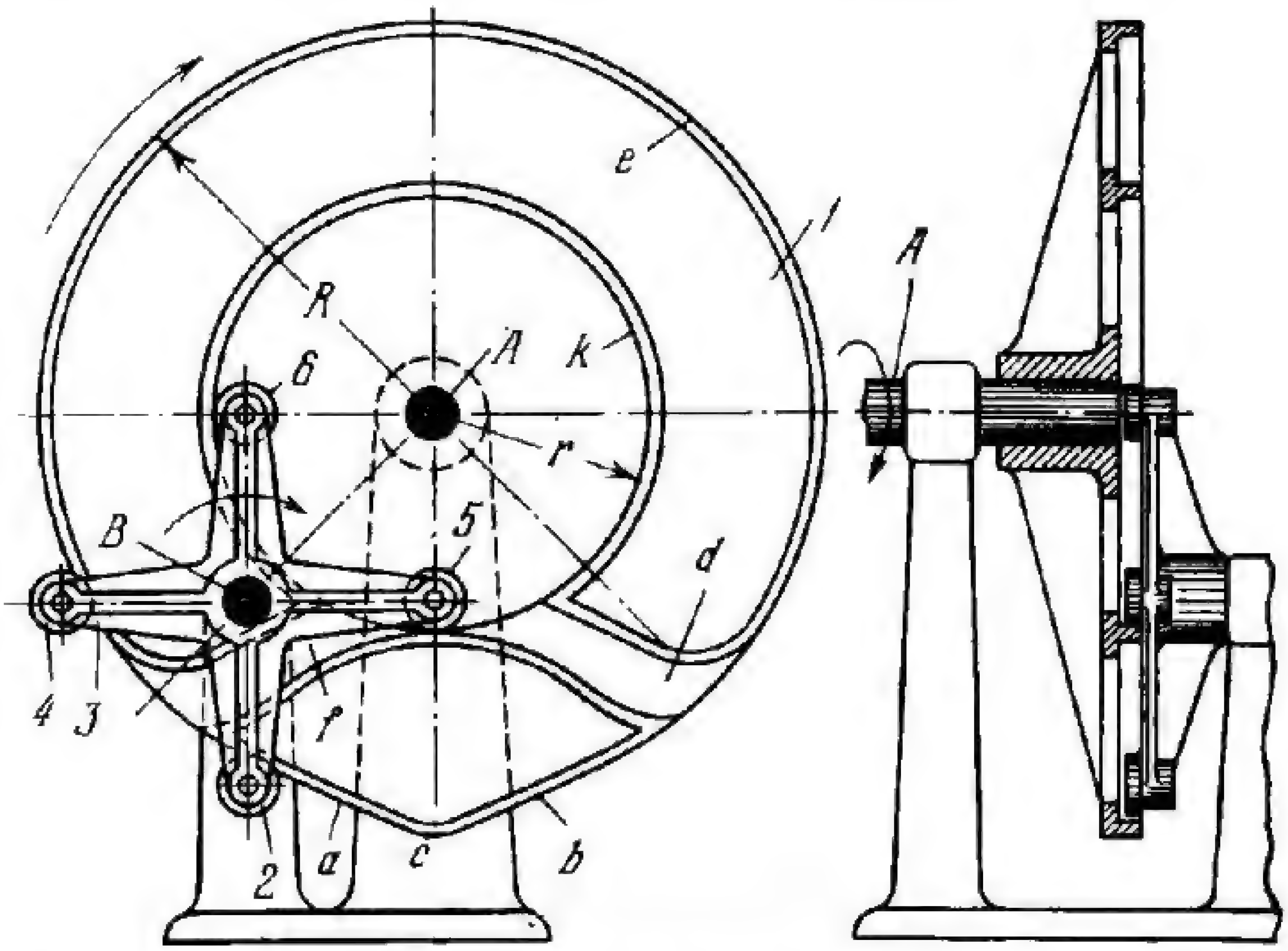
Disk *1* is keyed to shaft *7*, rotates about fixed axis *A* and carries guides *a-a* along which lobe member *2* can slide. Member *2* has axial slot *b* through which the end of shaft *7* passes. Member *2* is held in its central position by springs *4*. Roller *3* rotates freely about fixed axis *B*. Follower *6* reciprocates in fixed guide *C* and carries roller *5* which rolls along the working surface of lobe member *2* and the contour of disk *1*. When shaft *7* with disk *1* rotates, lobe *d* of member *2* passes over roller *3*, displacing member *2* in guides *a-a* by overcoming the resistance of a spring *4*. At this, lobe *e* of member *2* contacts roller *5* and raises follower *6*.

3079	CAM MECHANISM FOR INTERMITTENT MOTION OF A RECIPROCATING SLIDE	SmC ML



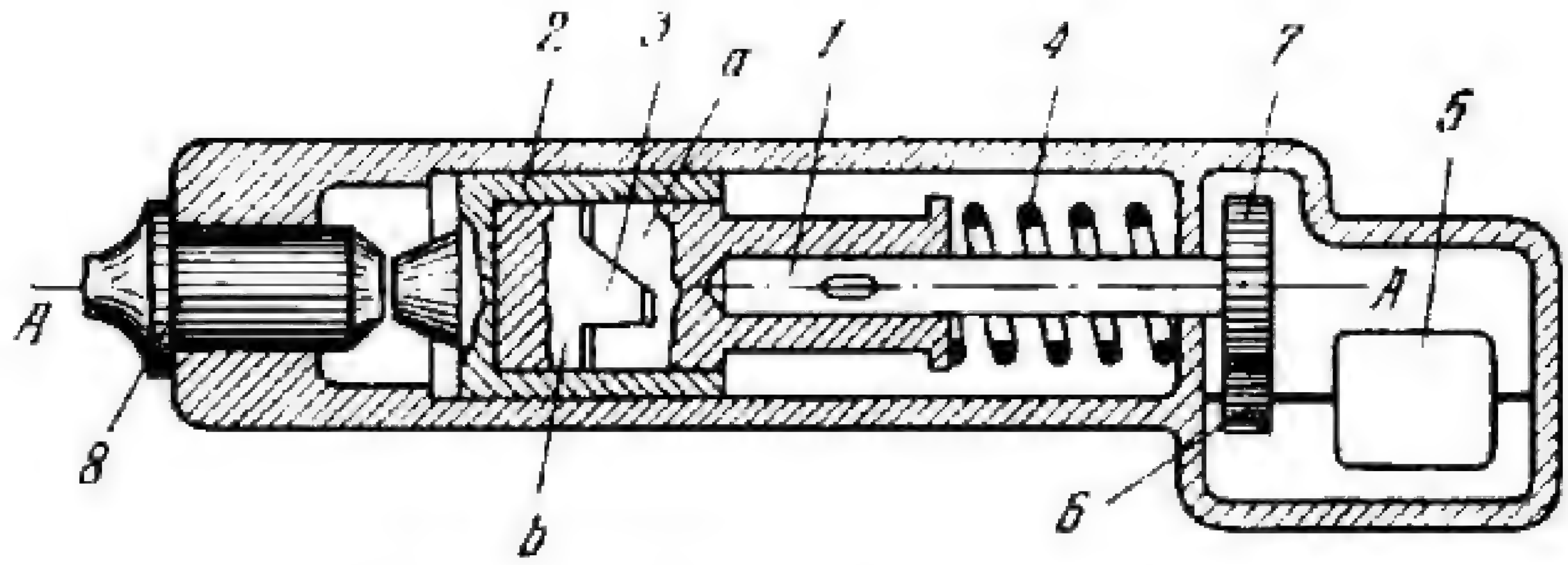
Slide 1 reciprocates continuously while slide 2 operates intermittently. In each cycle of the mechanism, slide 2 travels with slide 1 during one forward and one return stroke, and then dwells for the three consecutive forward and return strokes of slide 1. As shown, the slides are locked together by plunger 3 and are beginning their return stroke to the left. During the stroke, spring-loaded pawl 6 engages indexing pin a of cam 5, and turns the cam 90°. Pin b, when cam 5 is indexed, depresses pawl 6, overcoming the resistance of spring 9. As cam 5 turns, its projection f slides upward along deep slot c in housing 8 and drops into one of three shallow slots d. This withdraws plunger 3, disengaging it from slide 2 and compressing spring 4. As this occurs before the return stroke is completed, stop 10 of slide 1, through stop 11 of slide 2, pushes slide 2 to its extreme left-hand position where spring-loaded button 7 engages a depression in pad 12, holding slide 2 until projection f of cam 5 drops into deep slot c again. This occurs when cam 5 has been indexed through 270°, i.e. after three forward and three return strokes of slide 1. Shallow slots d in housing 8 prevent the cam from reversing after being indexed due to back drag on the indexing pins when they leave pawl 6.

3080	FACE CAM MECHANISM FOR INTERMITTENT MOTION OF A CROSS-SHAPED FOLLOWER	ŚmC ML



Cam *1* rotates about fixed axis *A* and has two working surfaces. The outer surface is composed of portion *acb* and circular arc *e* of radius *R*. The inner cam surface is composed of grooves *d* and *f*, and circular arc *k* of radius *r*. Cross-shaped follower *3* rotates about fixed axis *B* and carries rollers *2*, *4*, *5* and *6* which roll along the inner and outer working surfaces of cam *1*. When cam *1* rotates clockwise, portion *ac* acts against roller *2* and begins to turn follower *3*. At this, roller *5* enters groove *d* and roller *4* enters groove *f*. When these rollers come out of the grooves, follower *3* has been turned one-fourth of a revolution and rollers *5* and *4* begin to roll around concentric outer and inner surfaces *e* and *k*, locking follower *3* in its long dwell position. Positive motion is achieved because the rollers simultaneously roll along the corresponding portions of the working surfaces.

3081	CAM-TYPE OPERATING MECHANISM OF A PORTABLE ELECTRIC HAMMER	SmC ML



Rotation is transmitted from electric motor 5 through gears 6 and 7 to shaft 1. Shaft 1 rotates about axis A and is rigidly attached to member a of cam device 3 which resembles a claw clutch. Member b of device 3 is rigidly attached to striker 2 which reciprocates, without rotation, along axis A. Striker 2 strikes head 8. Thus, rotation of shaft 1 is converted into reciprocation of striker 2 by means of cam device 3. Spring 4 serves as a shock-absorber.

3082	TWO-CAM DIFFERENTIAL MECHANISM FOR VARYING THE FOLLOWER STROKE	SmC ML

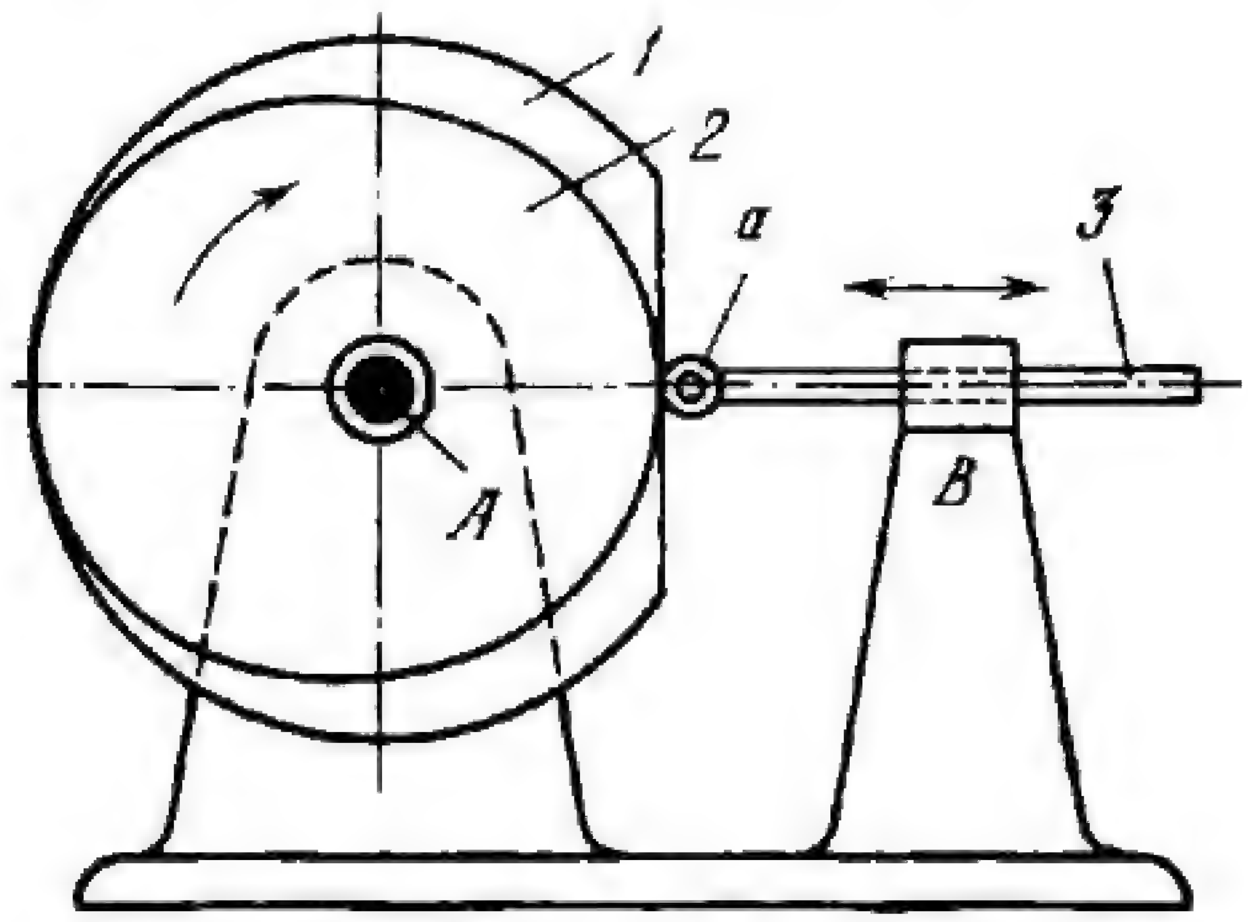
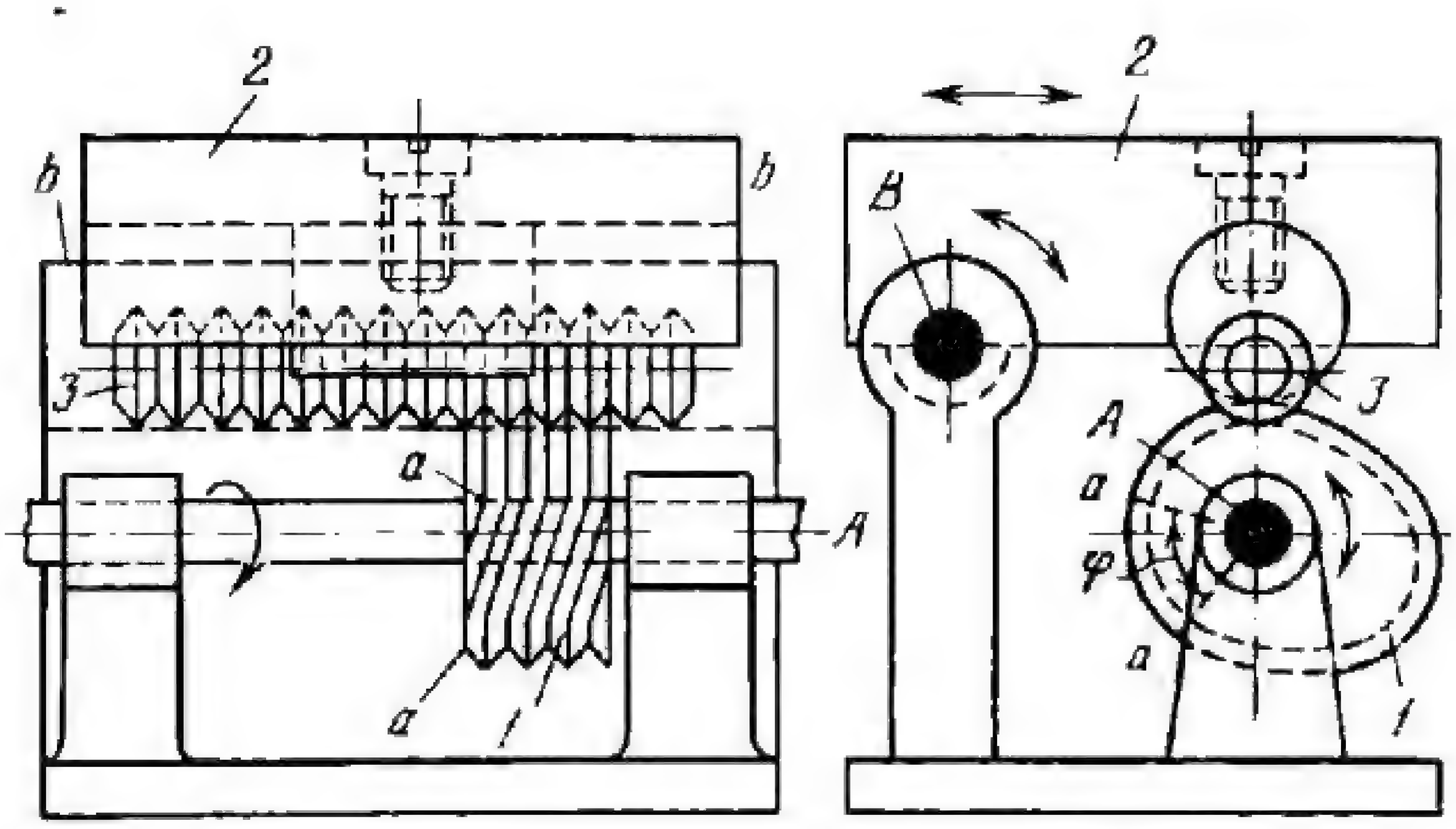


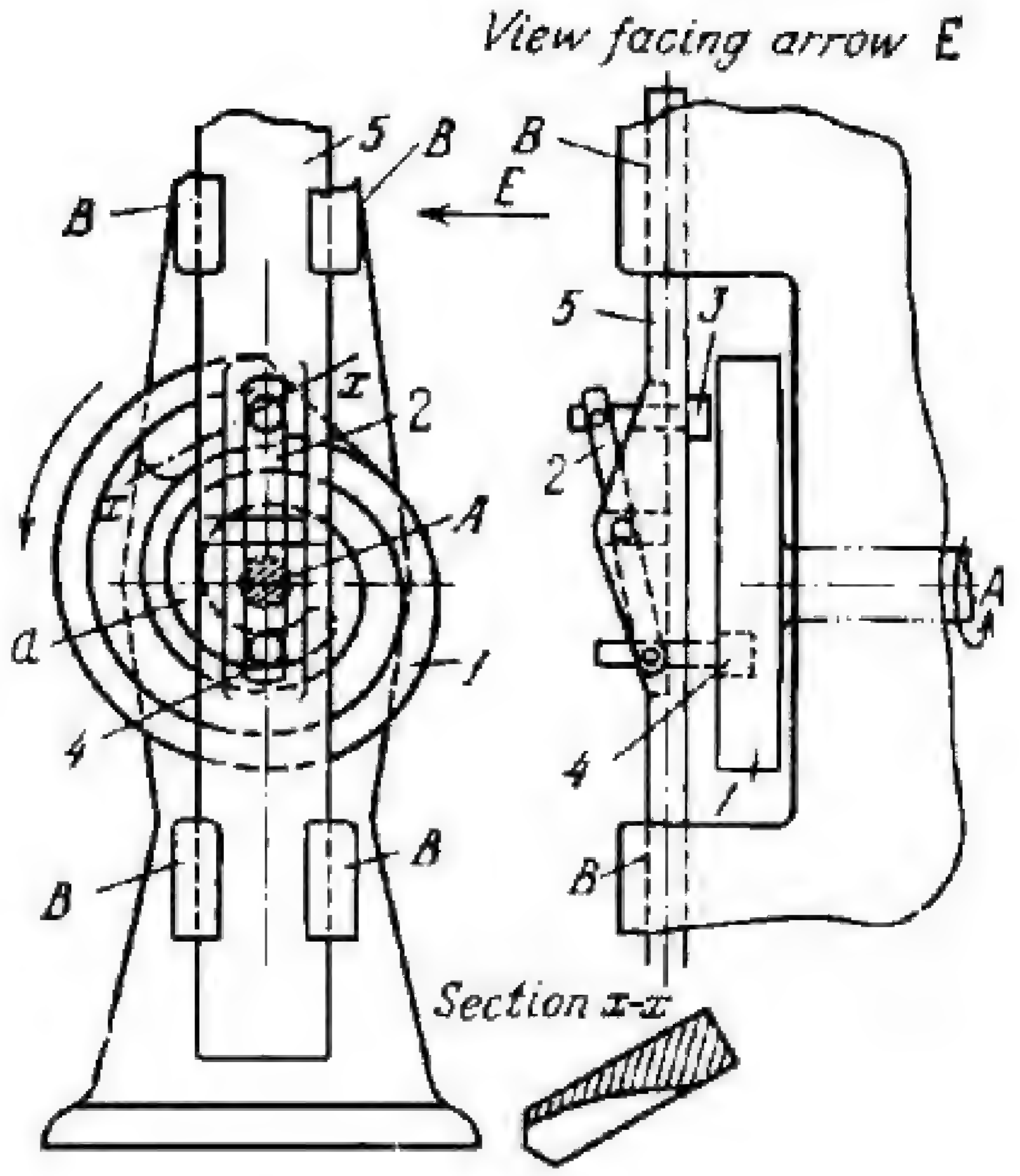
Plate cams 1 and 2 have different contours and are driven independently at different angular velocities about fixed axis A. Follower 3 reciprocates in fixed guide B and carries roller a which is wide enough to roll along the contours of either or both cams, 1 and 2. Thus the stroke and type of motion of follower 3 varies.

3083	SPATIAL DOUBLE-ACTING CAM MECHANISM	SmC ML



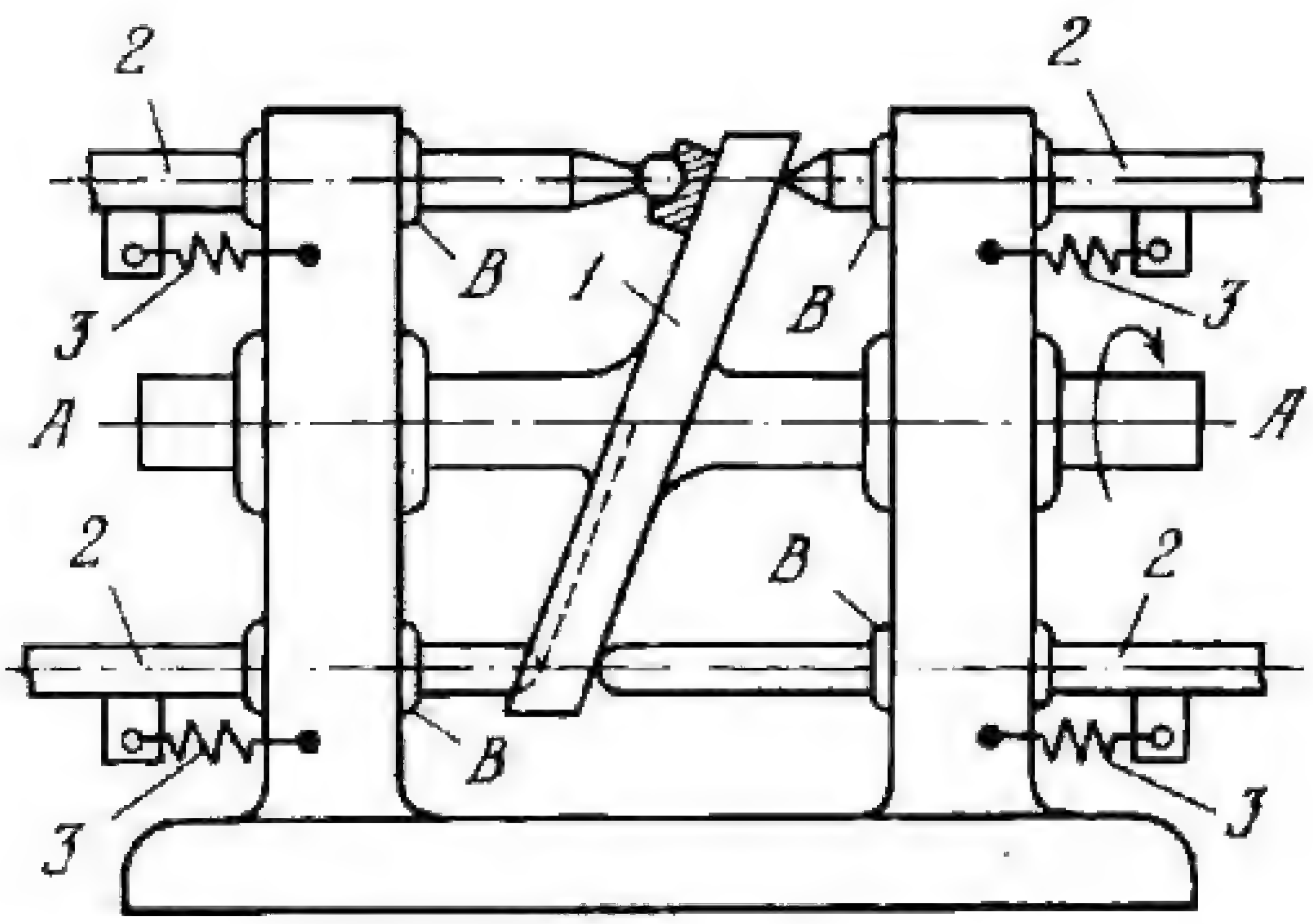
Cam *1* rotates about fixed axis *A* and its working surface consists of a continuous vee-groove, making several turns, which engages corresponding grooves in follower *3*. The grooves in follower *3* are not continuous, but are separate annular grooves. Over a certain angle φ, corresponding to portion *a-a* of the working surface, the vee-grooves are deflected to one side a distance equal to the pitch of the grooves. Portion *a-a* is along a circular arc described from centre *A*. When cam *1* rotates, link *2* with follower *3* turns about fixed axis *B* until the ridges of portion *a-a* of the cam engage the grooves of follower *3*. Then link *2* has a dwell in its oscillating motion but begins to slide along guides *b-b* a distance equal to one pitch of the grooves. Thus the motion of link *2* consists of oscillation with a dwell about axis *B* and a horizontal indexing motion, parallel to axis *A*, equal to one pitch per revolution of cam *1*.

3084	SPATIAL SPIRAL-GROOVE FACE CAM MECHANISM FOR A RECIPROCATING MOTION	SmC ML



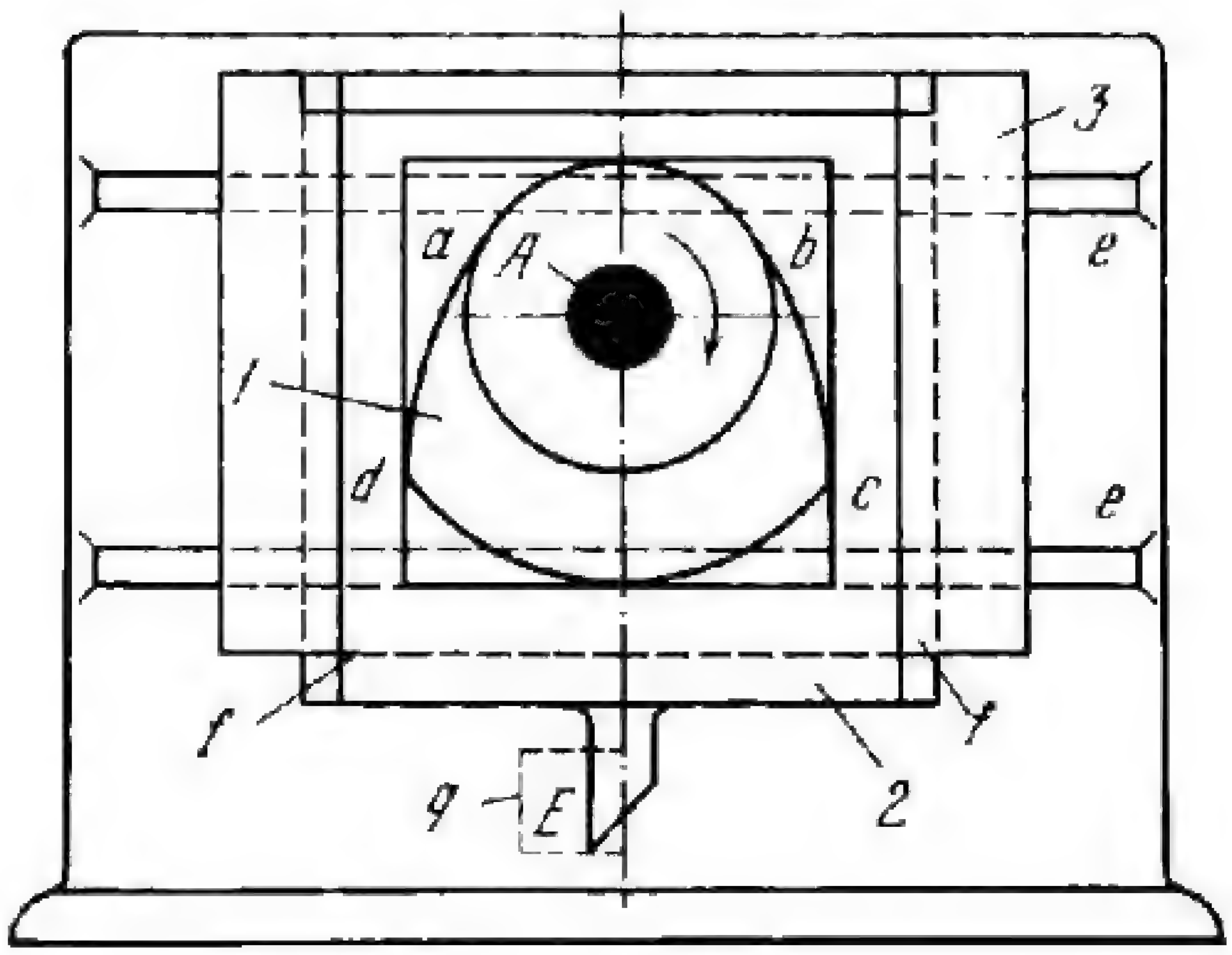
Cam *1* rotates about fixed axis *A* and has spiral groove *a*. Slide *5* reciprocates in fixed guides *B-B* and carries rocker arm *2* to which the stud shafts of two rollers, *3* and *4*, are pivoted. The rollers alternately engage groove *a* (see view facing arrow *E*). When the cam turns $1^1/_2$ revolutions, one of the rollers, for example *3*, runs up the inclined surface at the outer end of spiral groove *a* (see Section *x-x*) and is thereby pushed out of engagement with the groove. At the same time, roller *4* is swivelled into engagement with the inner end of groove *a*, and slide *5* is reversed.

3085	SPATIAL CYLINDRICAL RIDGE CAM MECHANISM OF THE SLANTED WASHER TYPE WITH VARIOUS FOLLOWERS	SmC ML



Cylinder cam *1* with a ridge designed as a slanted washer rotates about fixed axis *A-A*. Followers *2* reciprocate in fixed guides *B*. The parts of the followers in contact with the cam are of different designs. The followers are held in contact with cam *1* by springs *3*.

3086	DOUBLE CONSTANT-BREADTH CAM MECHANISM	SmC ML

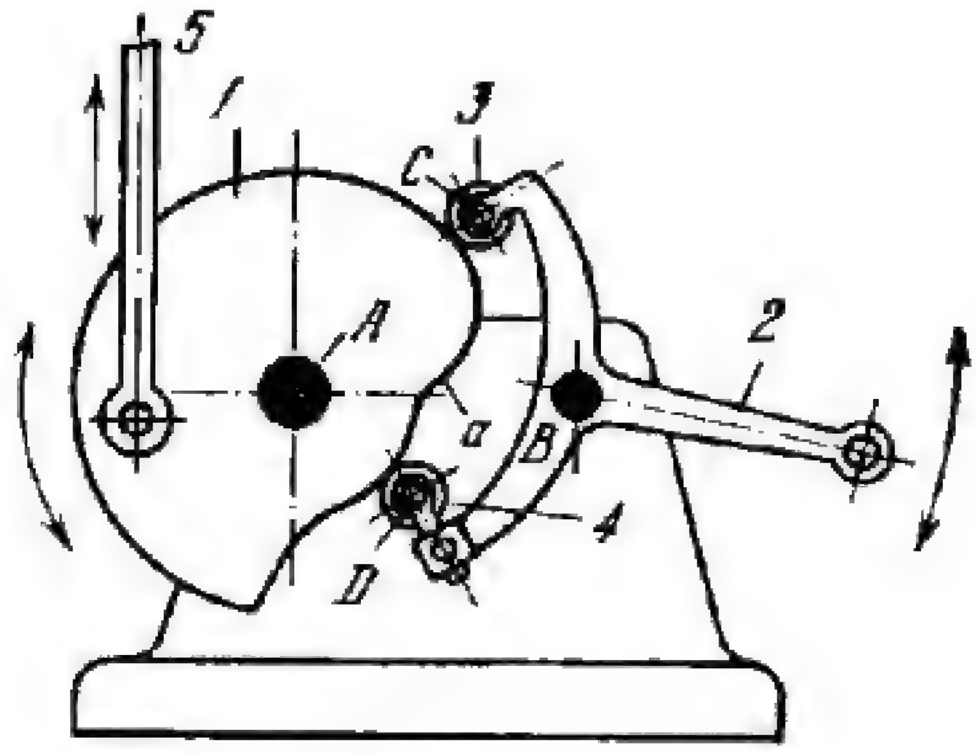


Cam *1* rotates about fixed axis *A*. When cam *1* rotates, point *E* of slide *2* follows square path *q*. Cam *1* is in contact with the four flat faces of the square opening in slide *2* which reciprocates vertically in guides *f-f* of slide *3*. Slide *3* reciprocates horizontally along fixed guides *e-e*. The contour of cam *1* is made up of four circular arcs, with concentric portions *ab* and *dc* described from centre *A*, and portions *bc* and *ad* from centres *d* and *c*. When the upper and lower faces of the square opening contact portions *ab* and *dc* of the cam, slide *3* travels horizontally together with inner slide *2*. At this, point *E* describes the horizontal parts of its path. When the upper and lower faces of the opening contact portions *bc* and *ad*, slide *3* is stationary and slide *2* travels vertically. At this, point *E* describes the vertical parts of its path *q*.

3087

CAM MECHANISM WITH A TWO-ROLLER FOLLOWER

SmC
ML

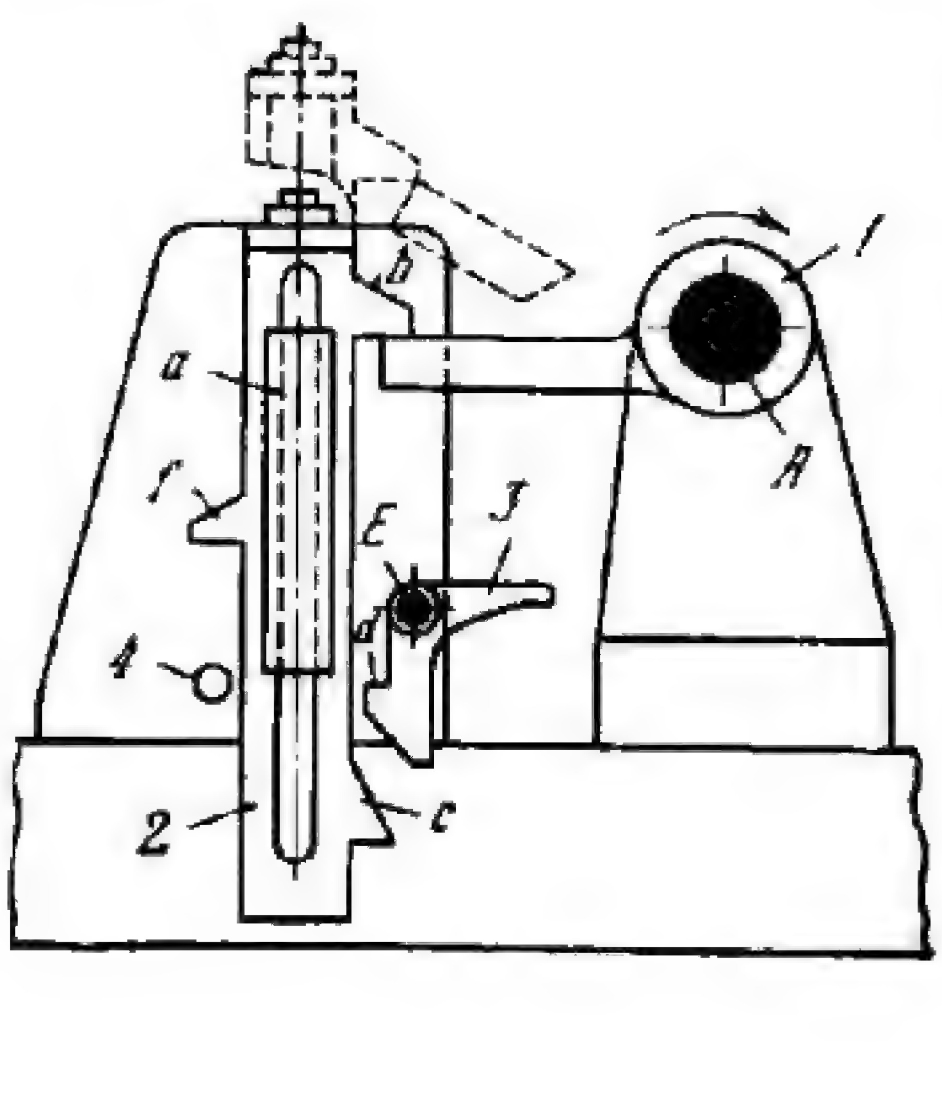


Tie-rod *5* transmits oscillating motion to cam *1* about fixed axis *A*. Follower *2* oscillates about fixed axis *B* and carries two rollers, *3* and *4*, which roll along working surface *a* of cam *1*. Positive motion is achieved because the distance $\overline{CD}$ between two points lying on the theoretical, or pitch, curve (not shown) is equal for all positions of centres *C* and *D* of rollers *3* and *4*.

3088

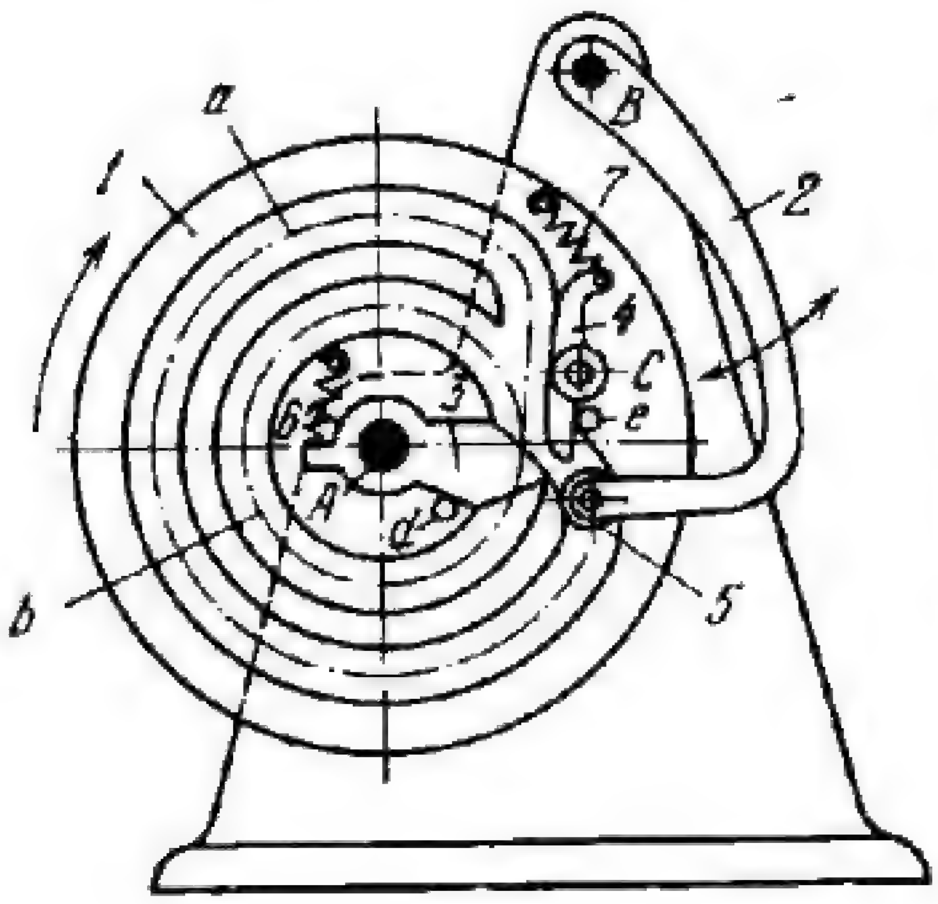
ROTATING LEVER CAM MECHANISM

SmC
ML



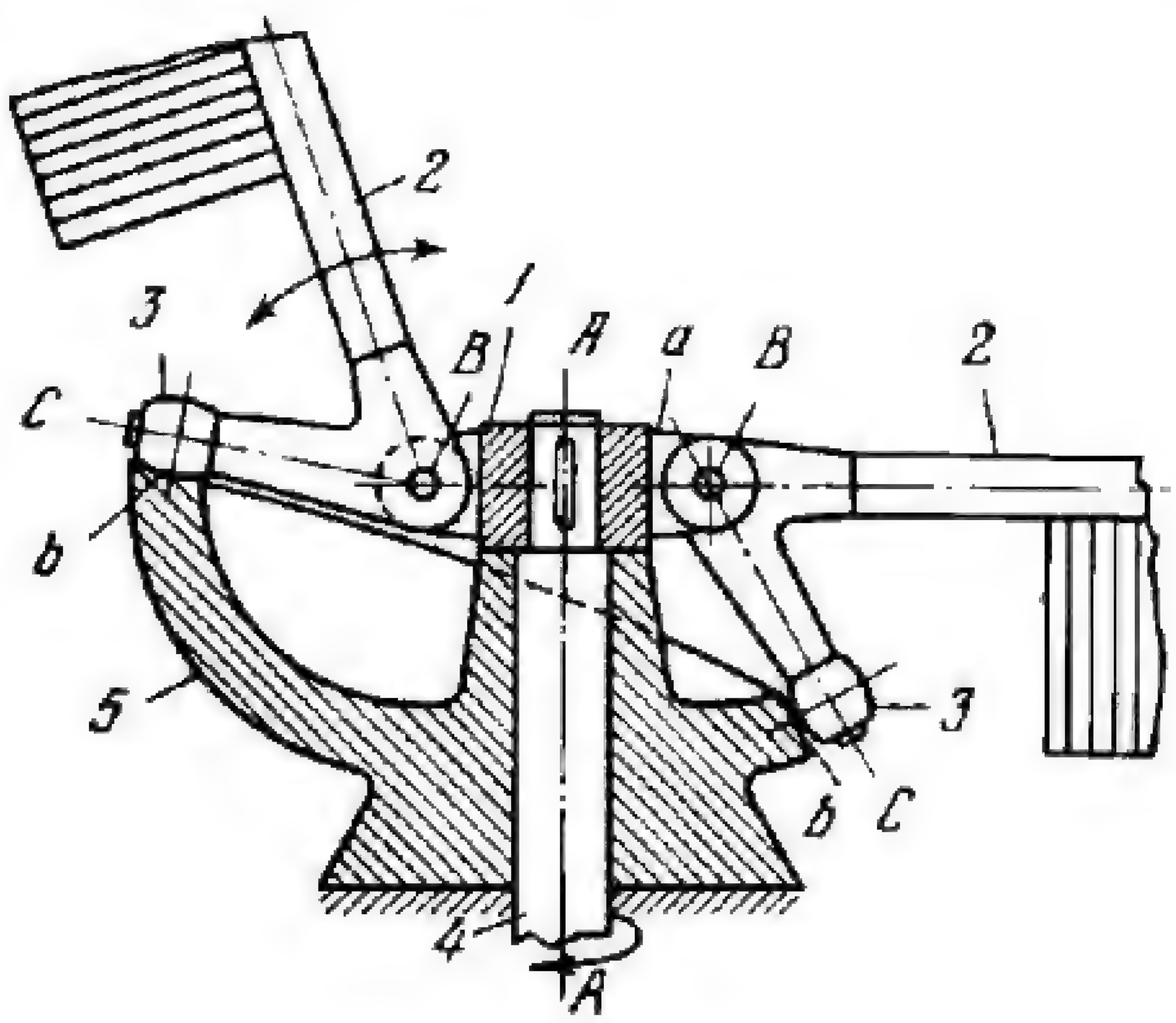
Lever (driver) *1* rotates about fixed axis *A*. Slide *2* reciprocates vertically along fixed guides. When driver *1* rotates clockwise, it engages lug *b* of follower *2*, raising the slide to the position shown by the dash lines. In this position, the slide is indexed by latch *3* whose lower lug *d* engages lug *c* of the slide. In the next revolution of driver *1* it turns latch *3* about fixed axis *E* so that it releases slide *2* which drops until lug *f* reaches pin *4*.

3089	TWO-GROOVE FACE CAM MECHANISM	SmC ML



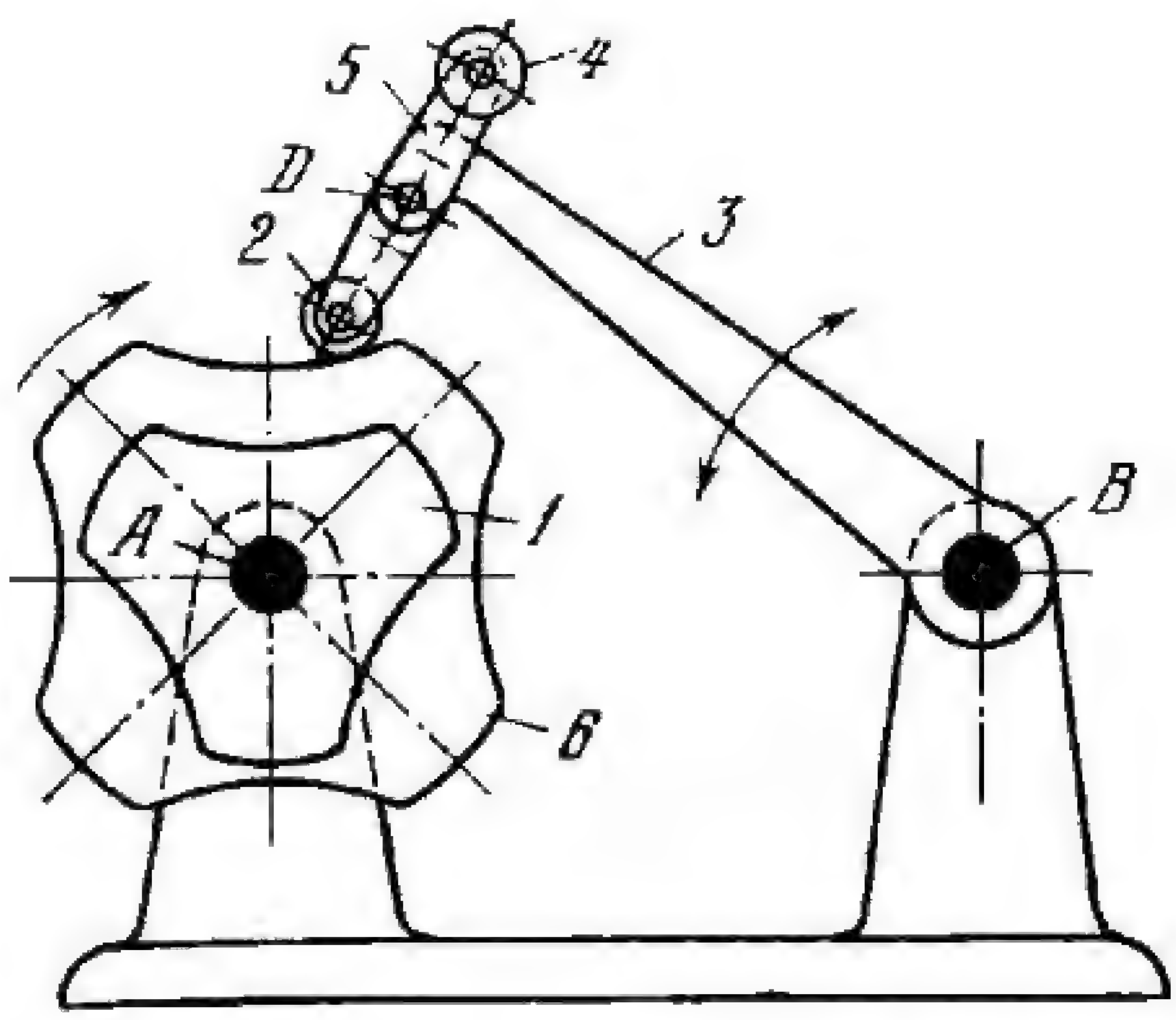
Cam *1* rotates about fixed axis *A* and has two grooves, *a* and *b*. Follower *2* oscillates about fixed axis *B* and carries roller *5* which rolls and slides alternately along grooves *a* and *b*. A full cycle corresponds to two revolutions of cam *1*. Roller *5* is switched over from one groove to the other by switching members *3* and *4* which turn about axes *A* and *C*. Members *3* and *4* are held against stop pins *d* and *e* by springs *6* and *7*.

3090	SPATIAL CAM MECHANISM OF A SELF-RAKE REAPER	SmC ML



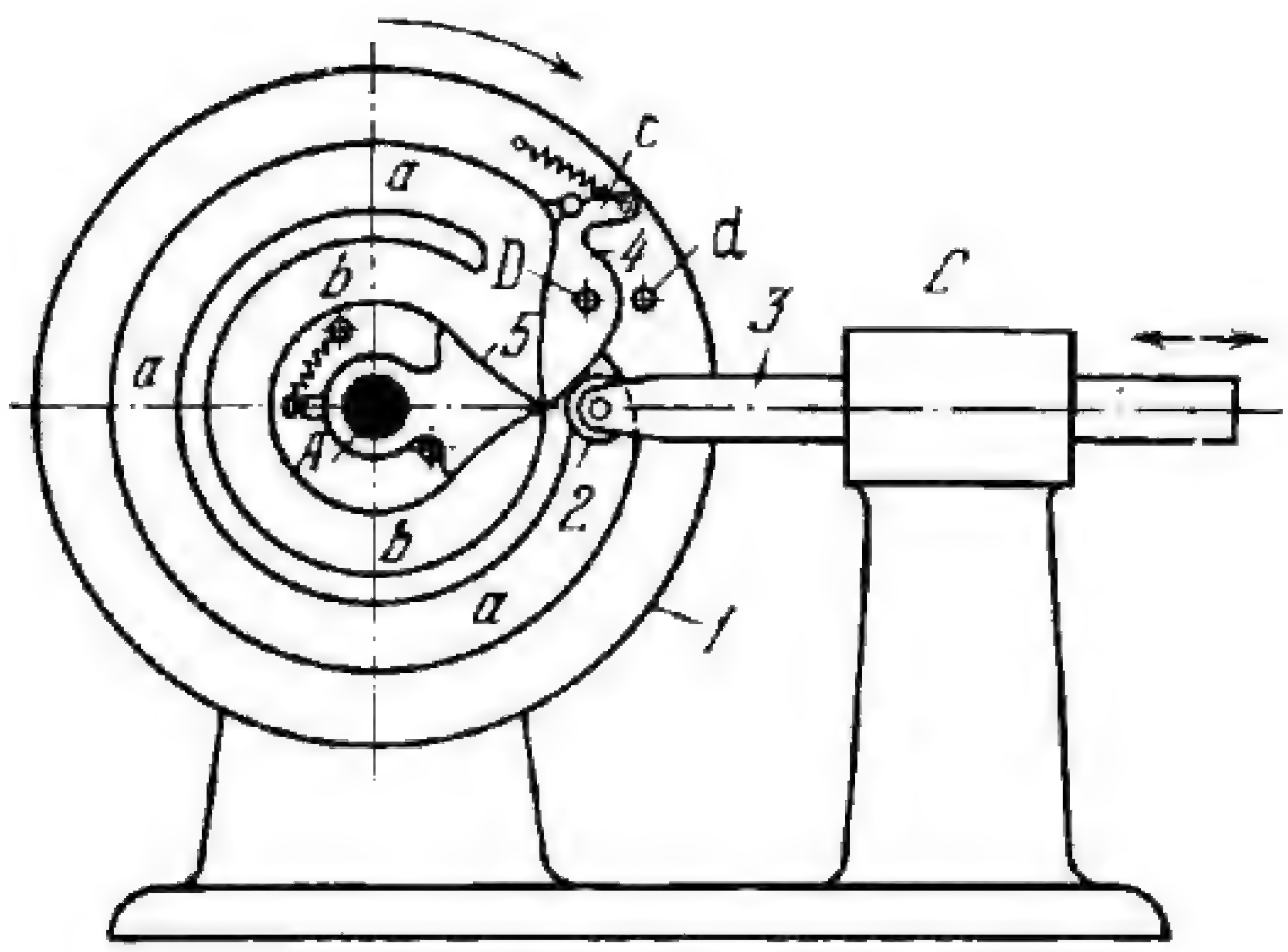
Head *1* is keyed to shaft *4* and rotates about fixed axis *A*-*A*. Head *1* has four symmetrically located eyes *a* which are connected by turning pairs *B* to rakes *2*. Rakes *2* carry barrel-shaped rollers *3* which rotate freely about axes *C* and roll along curvilinear working surface *b* of fixed cam *5*. When shaft *4* rotates, rakes *2* have a complex motion about crossed axes *A*-*A* and *B* which are perpendicular to one another.

3091	QUICK-CHANGE DOUBLE PLATE CAM MECHANISM	SmC ML



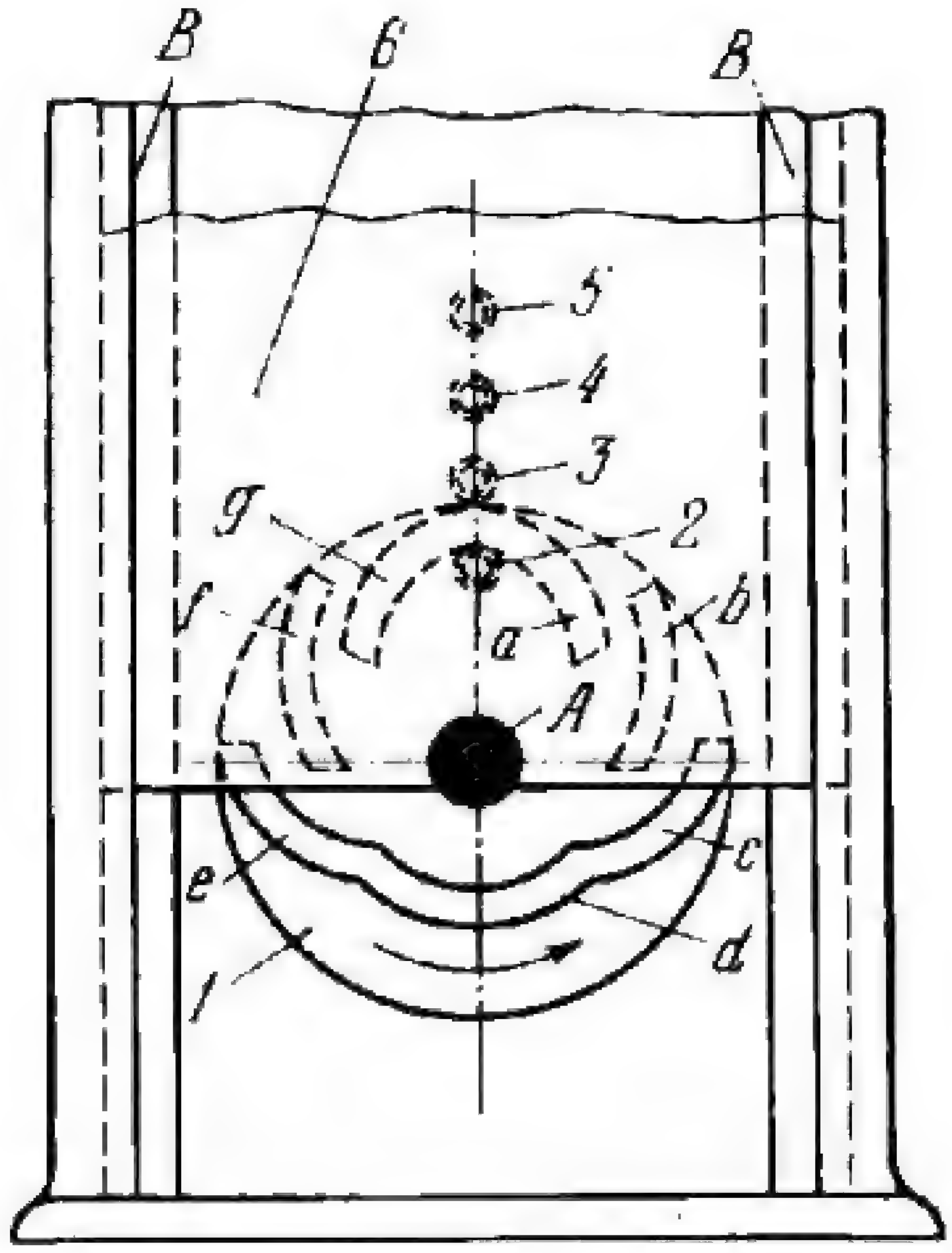
Rigidly attached cams *1* and *6* rotate about fixed axis *A*. Follower *3* oscillates about fixed axis *B* and is rigidly attached by some clamping facility to crosspiece *5* which carries rollers *2* and *4*. As shown, roller *2* rolls along the working surface of cam *6*. Crosspiece *5* can be unclamped, turned about axis *D* and reclamped so that roller *4* rolls along the working surface of cam *1*, thereby changing the type of motion of follower *3*.

3092	**TWO-GROOVE FACE CAM MECHANISM WITH FOLLOWER DWELL IN THE EXTREME POSITIONS**	**SmC** **ML**



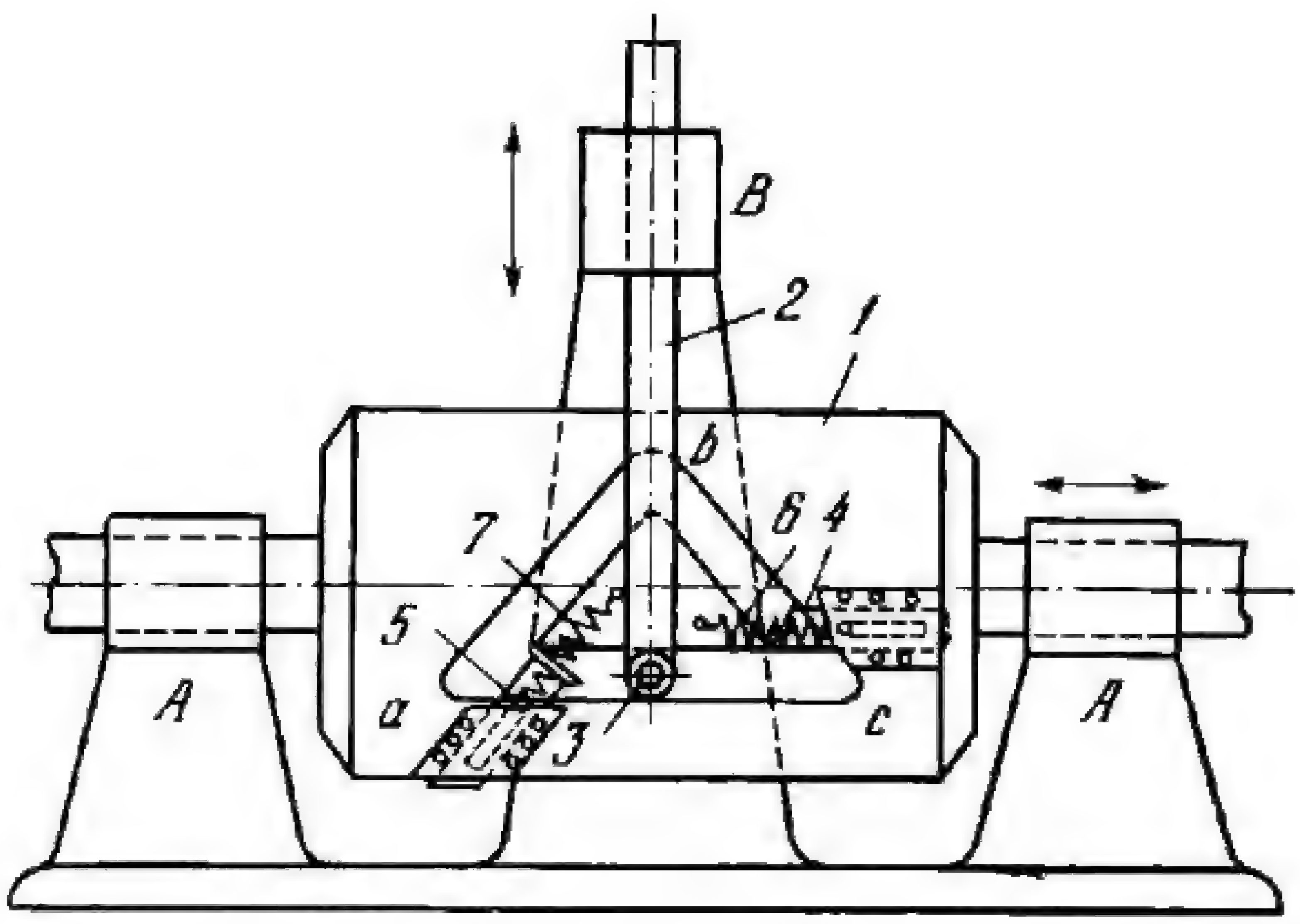
Cam *1* rotates about fixed axis *A* and has two concentric circular grooves ***a*** and ***b***. Follower *3* reciprocates in fixed guide ***C*** and carries roller *2* which rolls and slides alternately in grooves ***a*** and ***b***. A full cycle corresponds to two revolutions of cam *1* during each of which follower *3* dwells in one of its extreme positions determined by grooves ***a*** and ***b***. Roller *2* is switched over from groove ***a*** to groove *b* by profiled switching member *4* which is turned by roller *2* about axis *D* so that it connects groove ***a*** to groove *b*. At this point, lug ***c*** of member *4* runs up against pin *d*. The roller is switched over from groove *b* to groove ***a*** by profiled switching member *5* which operates similar to member *4*.

3093	FOUR-PROFILE FACE CAM MECHANISM	SmC ML



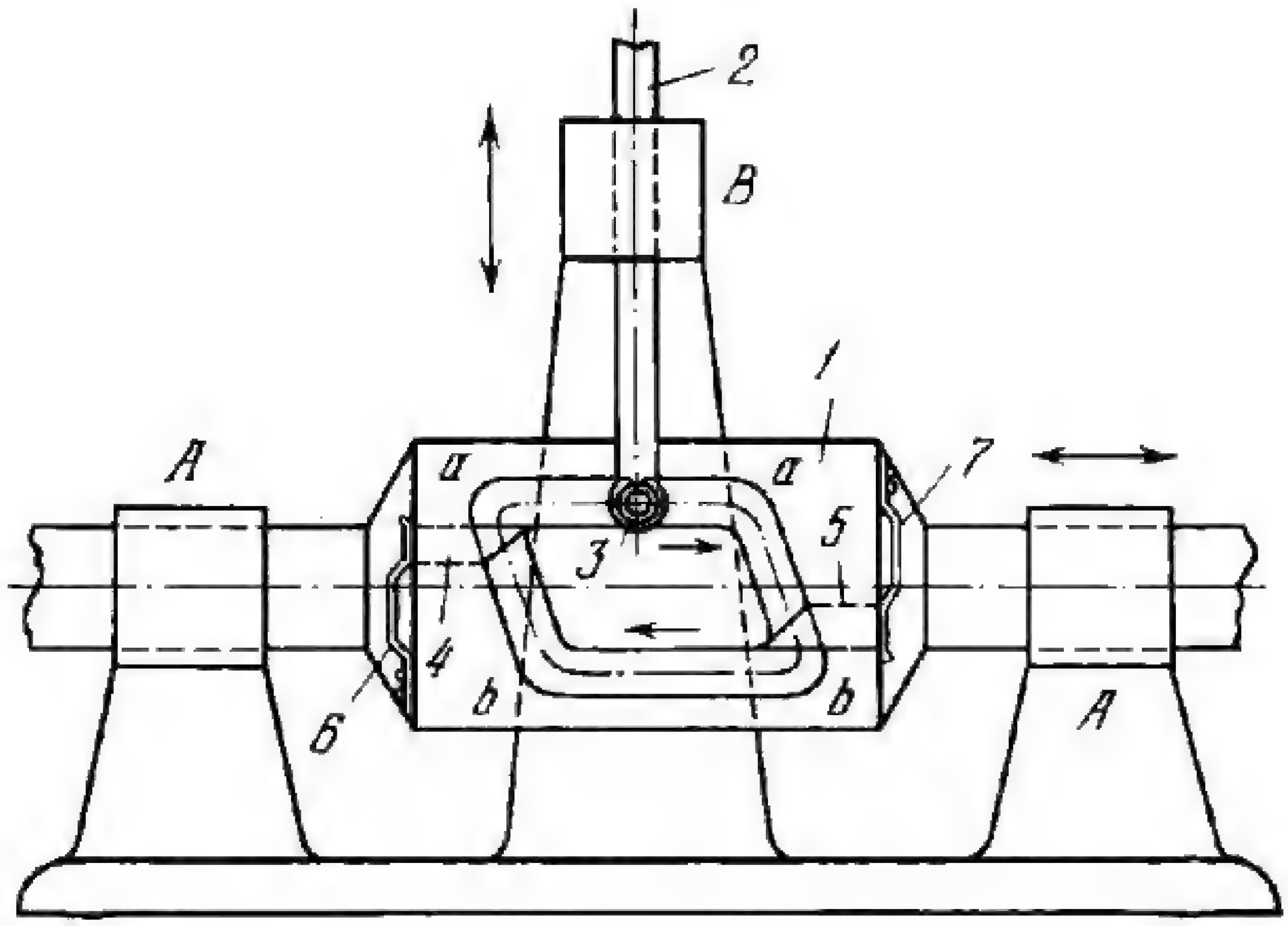
Cam *1* rotates about fixed axis *A* and has four profiled ridges. Follower *6* reciprocates in fixed guides *B-B* and carries four rollers, *2*, *3*, *4* and *5*. When cam *1* rotates counterclockwise, rollers *2*, *3*, *4* and *5* roll along cam ridges *a*, *b*, *c*, *d*, *e*, *f* and *g*, reciprocating follower *6*. When rollers *2* and *3*, *3* and *4*, and *4* and *5* roll along ridges *a*, *b* and *c*, respectively, follower *6* travels downward. Follower *6* has a dwell when rollers *4* and *5* roll along ridge *d* which is concentric to the shaft of cam *1*. When rollers *5* and *4*, *4* and *3*, and *3* and *2* roll along ridges *e*, *f* and *g*, respectively, follower *6* travels upward. Positive motion is achieved because the distance between the theoretical, or pitch, curves of the two sides of each ridge is equal to the distance between the centres of adjacent rollers.

3094	TRIANGULAR-GROOVE SLIDING CAM MECHANISM	SmC ML



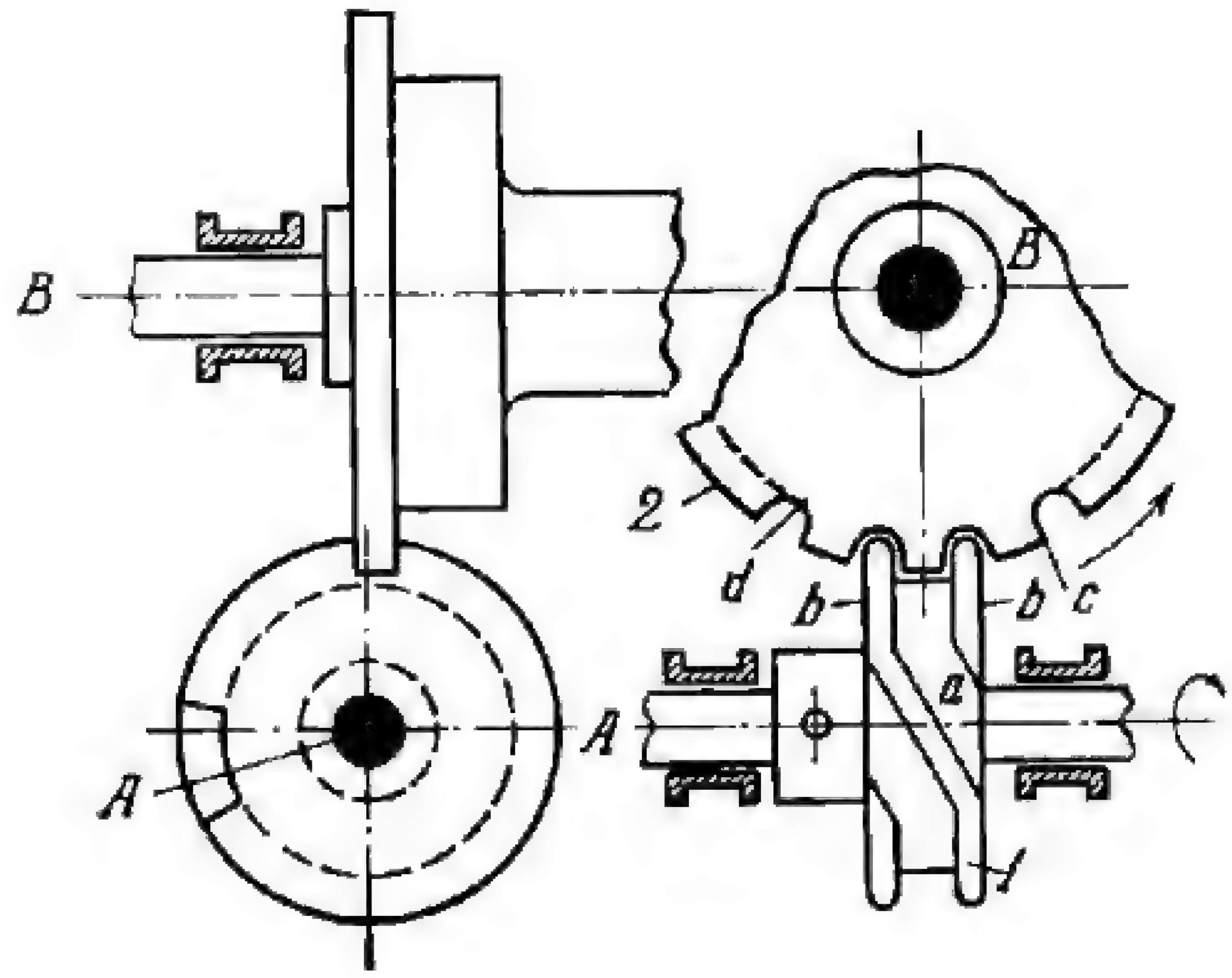
Cam 1 reciprocates in fixed guides *A-A* and has triangular groove *abc*. Follower 2 reciprocates in fixed guide *B* and carries roller 3 which rolls and slides along groove *abc*. When cam 1 reciprocates, groove *abc* acts on roller 3, reciprocating follower 2 in a direction perpendicular to the travel of cam 1 with a dwell while the roller passes along horizontal portion *ac* of the groove. Latch pins 4 and 5, actuated by springs 6 and 7, prevent the roller from reversing its direction of travel along the groove.

3095	PARALLELOGRAM-GROOVE SLIDING-CAM MECHANISM	SmC ML



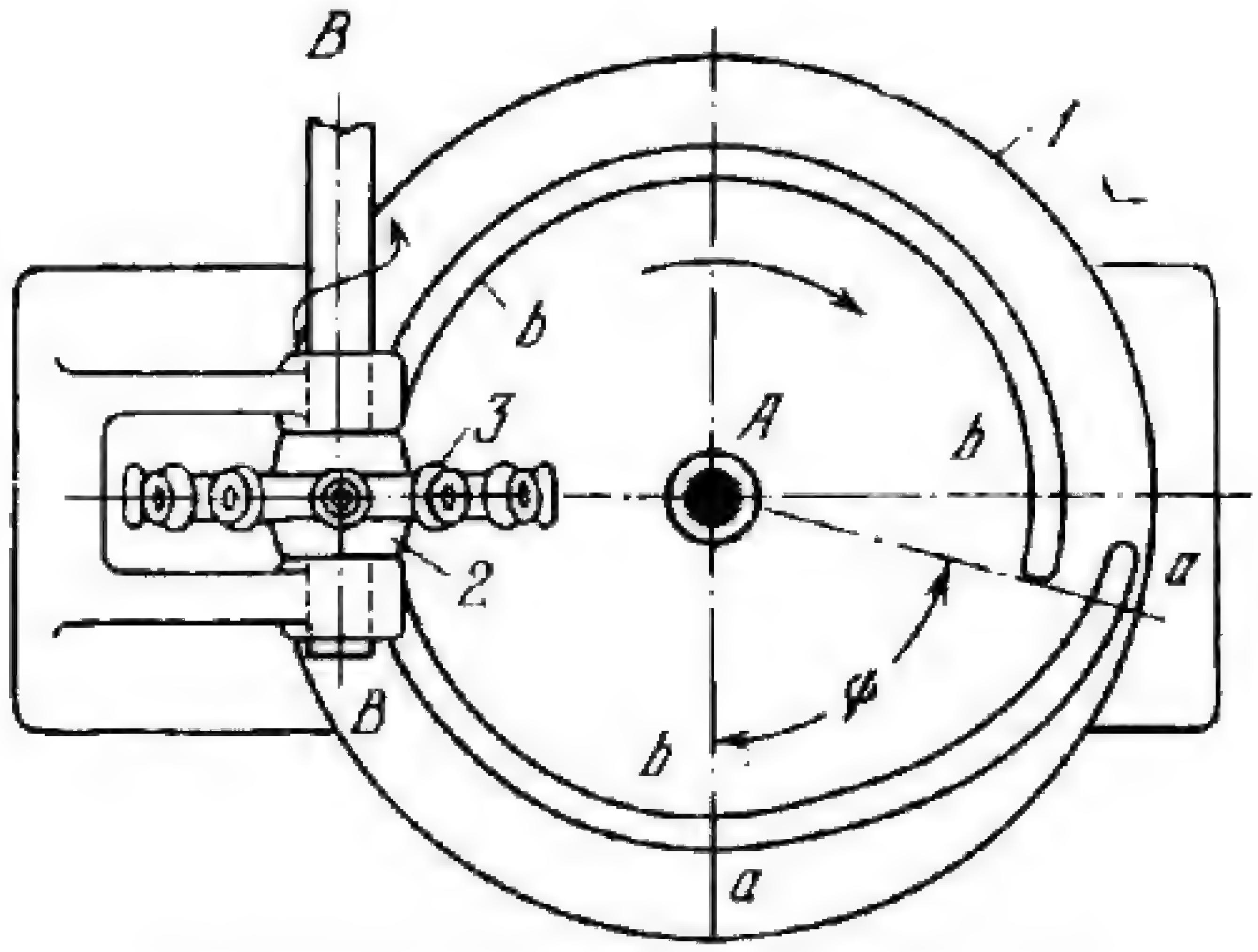
Cam *1* reciprocates in fixed guides *A-A* and has groove ***aabb*** in the shape of a parallelogram. Follower *2* reciprocates in fixed guide *B* and carries roller *3* which rolls and slides along groove ***aabb***. When cam *1* reciprocates, groove ***aabb*** acts on roller *3*, reciprocating follower *2* in a direction perpendicular to the travel of cam *1* with dwells while the roller passes along horizontal portions *aa* and *bb* of the groove. Latches *4* and *5*, actuated by flat springs *6* and *7*, prevent the roller from reversing its direction of travel along the groove.

3096	**SPATIAL INTERMITTENT CYLINDER CAM DRIVE MECHANISM**	SmC ML



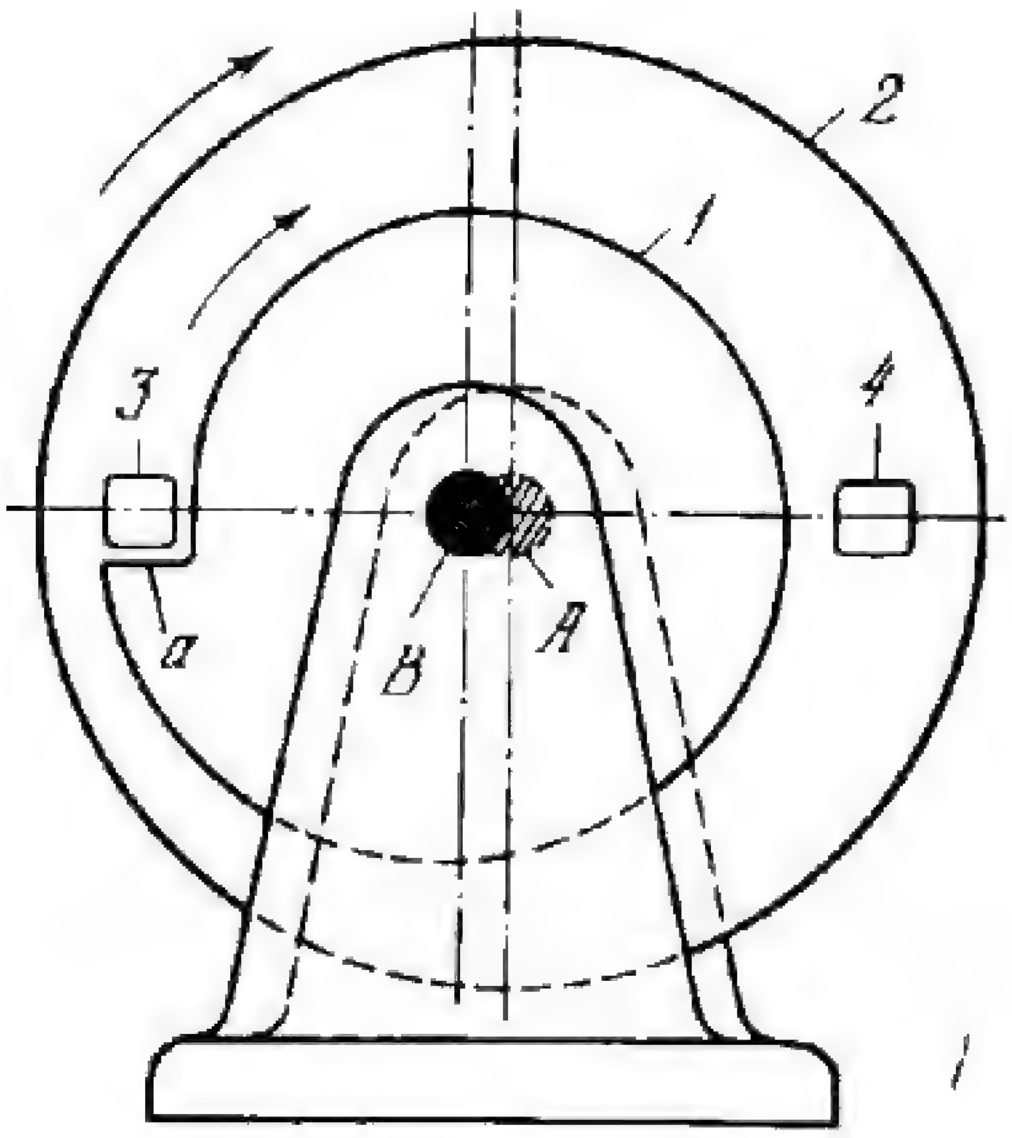
Cam *1* rotates about fixed axis *A* and has profiled ridge *a* and two rims *b*. Driven wheel *2* rotates about fixed axis *B* and has teeth *c* and tooth spaces *d* around its circumference. Axes *A* and *B* cross and are perpendicular to each other. When cam *1* rotates, ridge *a* turns wheel *2* through the angle $\varphi = \frac{2\pi}{z}$, where z is the number of teeth of wheel *2*. During the remainder of the revolution of cam *1*, one of the teeth of wheel *2* is between rims *b* of the cam, thereby preventing unintentional rotation of the wheel. When cam *1* rotates continuously, wheel *2* rotates intermittently with one long dwell per revolution of cam *1*.

3097	SPATIAL FACE CAM ROLLER GEAR DRIVE MECHANISM	SmC ML



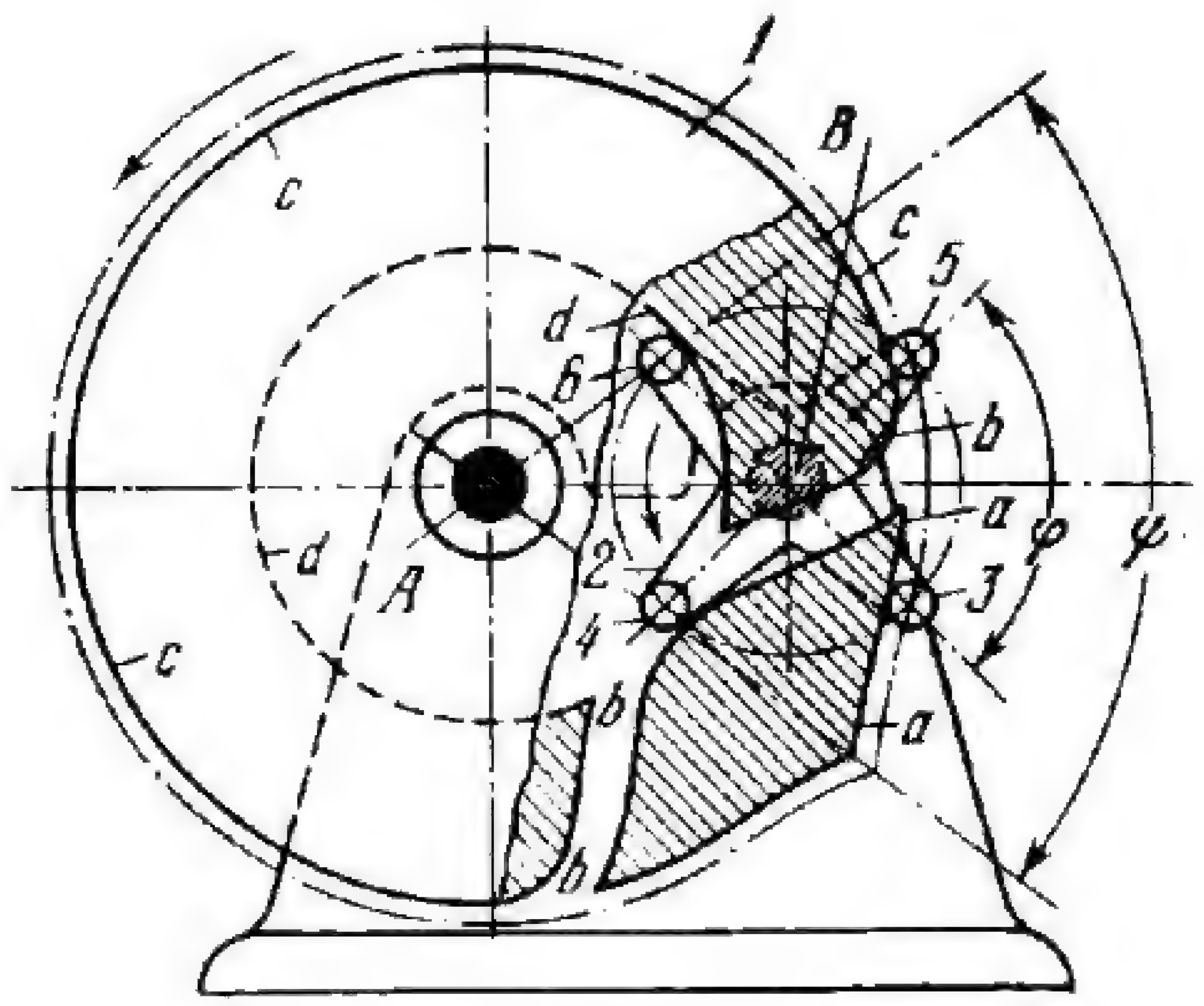
Face cam *1* rotates about fixed axis *A* and has a profiled ridge on one face composed of concentric circular portion *b-b*, along an arc described from centre *A*, and spiral portion *a-a*. Driven wheel *2* rotates about fixed axis *B-B* and carries rollers *3*, radially mounted around the circumference of the wheel. Axes *A* and *B-B* cross and are perpendicular to each other. When cam *1* turns through angle ψ, spiral portion *a-a* of its ridge acts on rollers *3* and turns wheel *2* through the angle $\varphi = \frac{2\pi}{z}$, where z is the number of rollers on wheel *2*. During the remainder of the revolution of cam *1*, two adjacent rollers *3* roll along the side surfaces of concentric portion *b-b* of the ridge, thereby preventing unintentional rotation of wheel *2*. When cam *1* rotates continuously, wheel *2* rotates intermittently with one long dwell per revolution of cam *1*.

3098	INTERMITTENT MOTION CAM MECHANISM	SmC ML



Cam *1* rotates about fixed axis *B* and has projection *a* which alternately engages square pins *3* and *4* of driven disk *2*. Disk *2* rotates about fixed axis *A*. Pins *3* and *4* are located symmetrically with respect to axis *A*. Owing to the eccentricity of axis *A* of disk *2* with respect to axis *B* of cam *1*, pin *3* slides out of engagement with projection *a* after one half revolution of cam *1*, and disk *2* is stationary during the second half revolution of cam *1*. Then projection *a* engages pin *4* and turns disk *2* again.

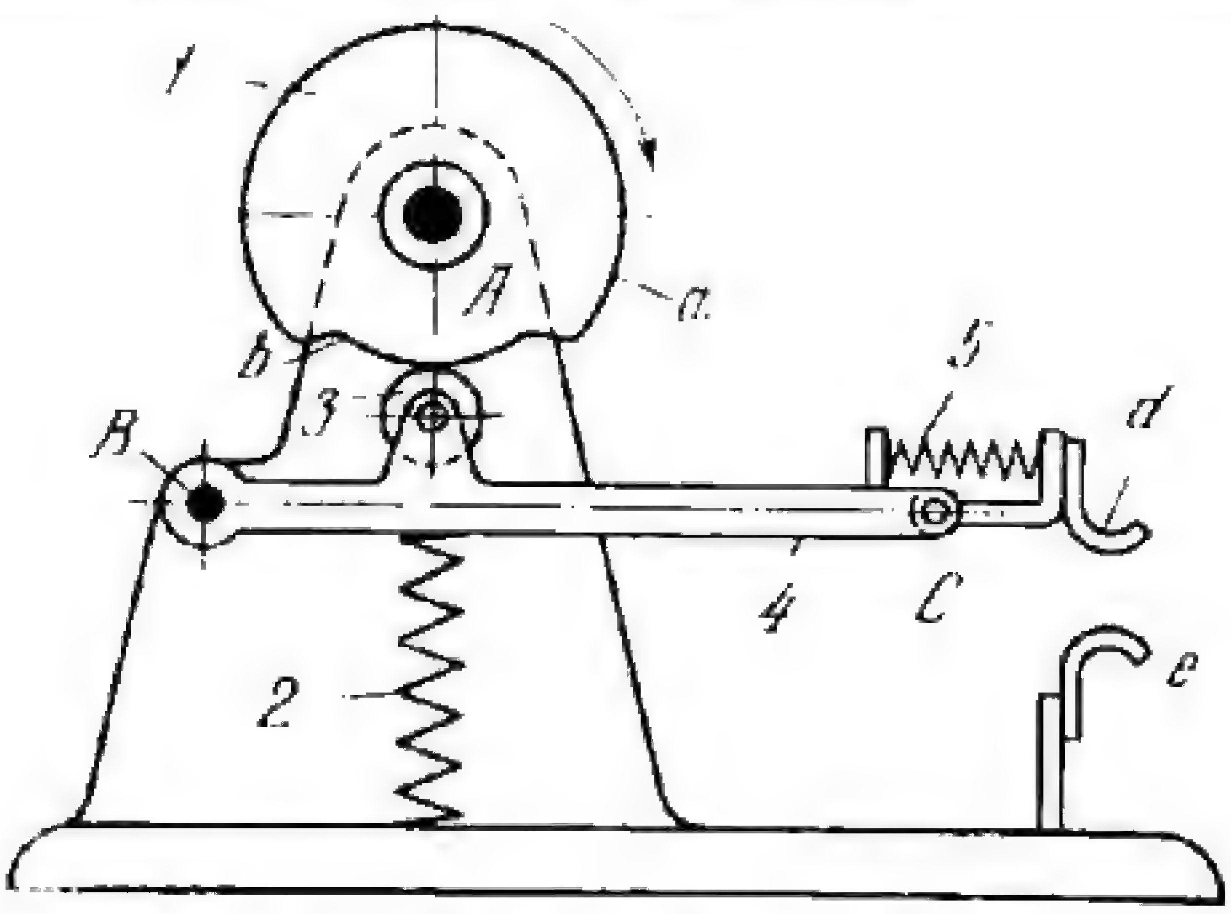
3099	FACE-CAM MECHANISM FOR INTERMITTENT MOTION OF A FOUR-ROLLER FOLLOWER	SmC ML



Cam *1* rotates about fixed axis *A* and its working surfaces consist of two curvilinear portions *a-a* and *b-b*, and two concentric circular arcs *c-c* and *d-d*, described from centre *A*. Cross-shaped follower *2* rotates about fixed axis *B* and carries rollers *3*, *4*, *5* and *6* which roll along the inner and outer working surfaces of cam *1*. When cam *1* rotates through angle ψ, follower *2* turns through the angle φ. The first half of this turning motion is accomplished by the action of portion *a-a* of the cam surface on roller *3*, and the second half by the action of profiled groove *b-b* on roller *4*. Upon further rotation of cam *1* through the angle $360° - \psi$, follower *2* has a dwell during which rollers *3*, *4*, *5* and *6* roll along outer and inner concentric circular arcs *c-c* and *d-d* of cam *1*, thereby preventing unintentional rotation of follower *2*.

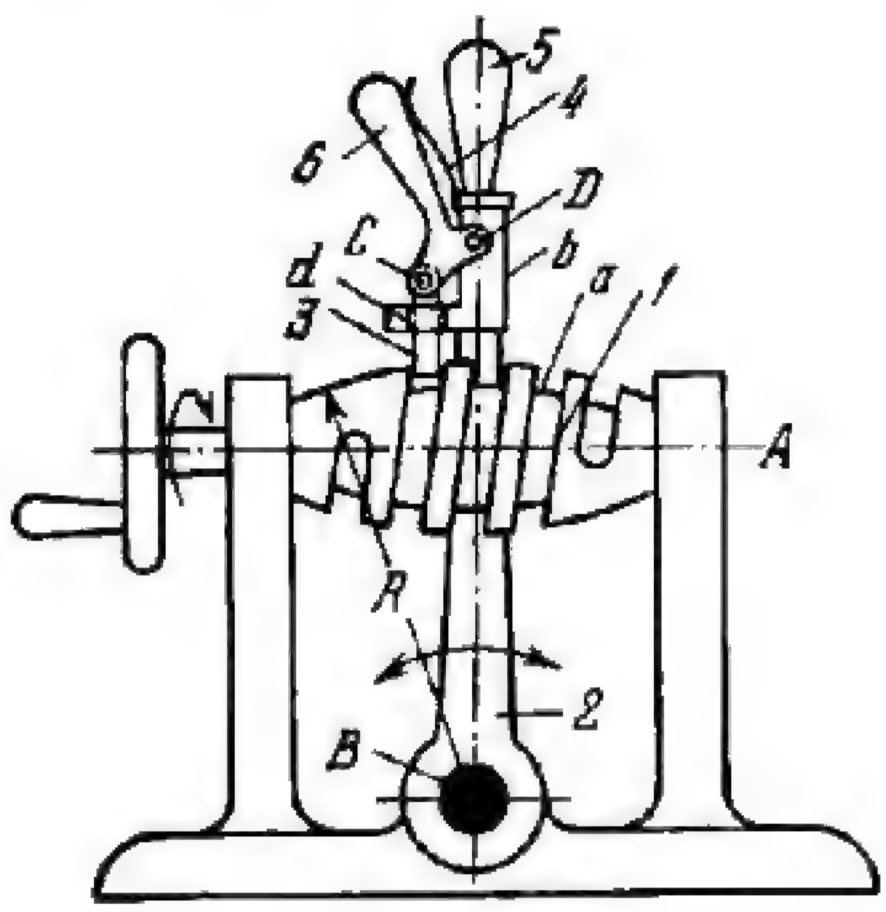
4. SWITCHING, ENGAGING AND DISENGAGING MECHANISMS (3100 through 3104)

3100	THREE-LINK PLATE CAM ENGAGING AND DISENGAGING MECHANISM	SmC SE



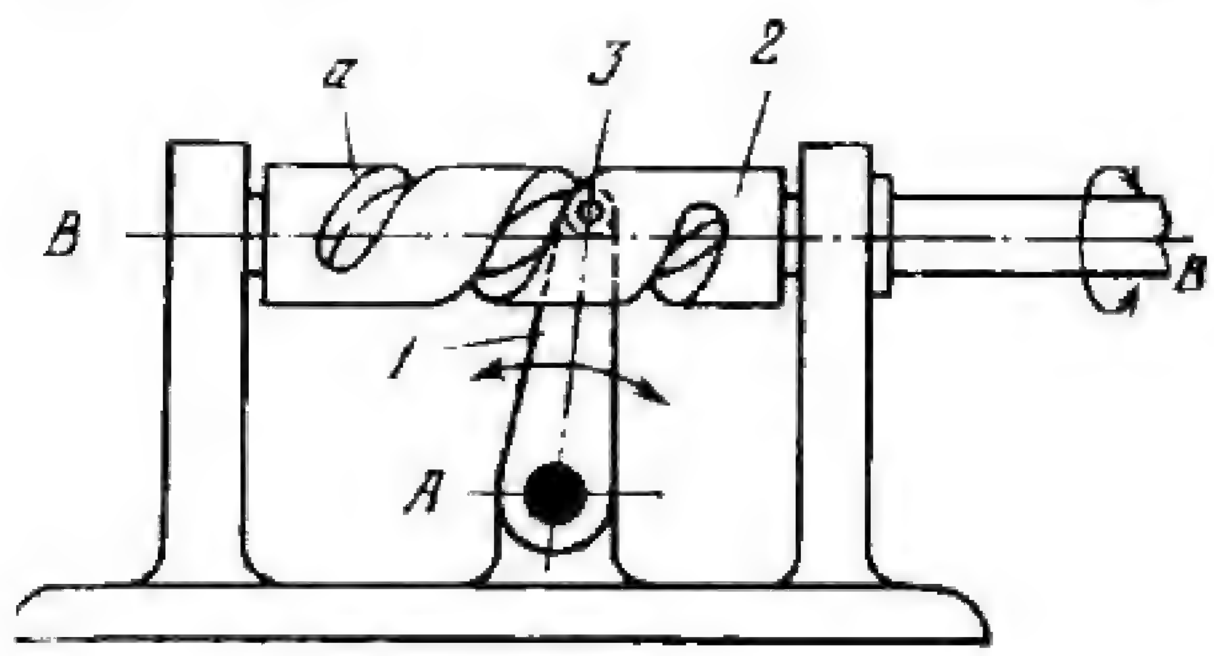
Cam *1* rotates about fixed axis *A* and its working surface is composed of concentric circular arcs *a* and *b* of different radii. Follower *4* oscillates about fixed axis *B* and carries roller *3* which rolls along the surface of cam *1*. Compression spring *2* holds roller *3* in contact with cam *1*. When cam *1* rotates, contacts *d* and *e* are periodically closed and opened. Proper closing of the contacts is ensured by spring *5* because contact *d* can turn slightly about axis *C*.

3101	SPATIAL GLOBOIDAL CAM MECHANISM WITH A DISENGAGEABLE FOLLOWER	SmC SE



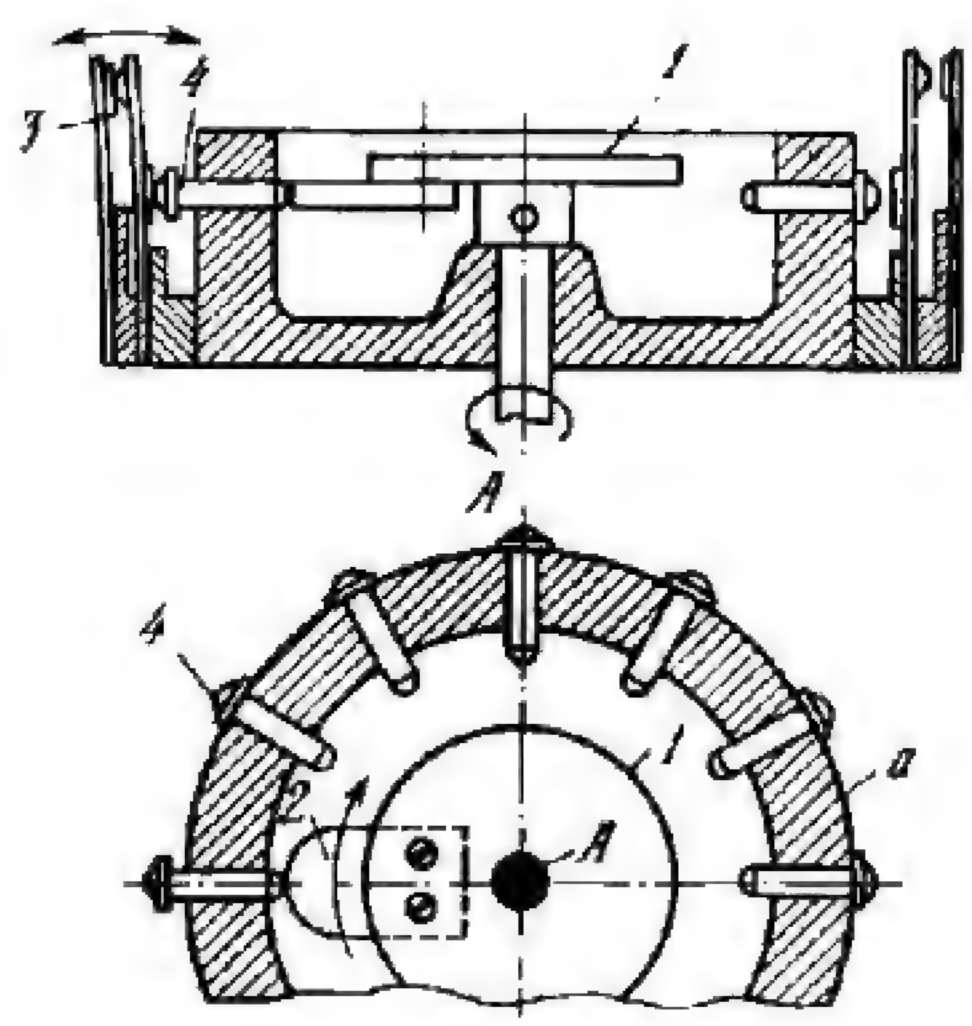
Cam *1* rotates about fixed axis *A* and its globoidal surface, in which helical cam groove *a* is machined, is generated by the revolution of a circular arc of radius *R* about axis *A*. Follower *2* oscillates about fixed axis *B* and has handle *5*. Pin *3* slides along groove *a* and is connected by turning pair *C* to latch *6* which turns about axis *D* of follower *2*. Pin *3* passes with some clearance through hole *d* in handle *5*. When cam *1* rotates, first in one direction and then in the other, follower *2* oscillates about axis *B*. The follower can be disengaged by pressing latch *6* to withdraw pin *3* from engagement with groove *a*. When latch *6* is released, flat spring *4* holds pin *3* in engagement with groove *a*.

3102 SPATIAL INVERSE CYLINDER CAM MECHANISM — SmC SE



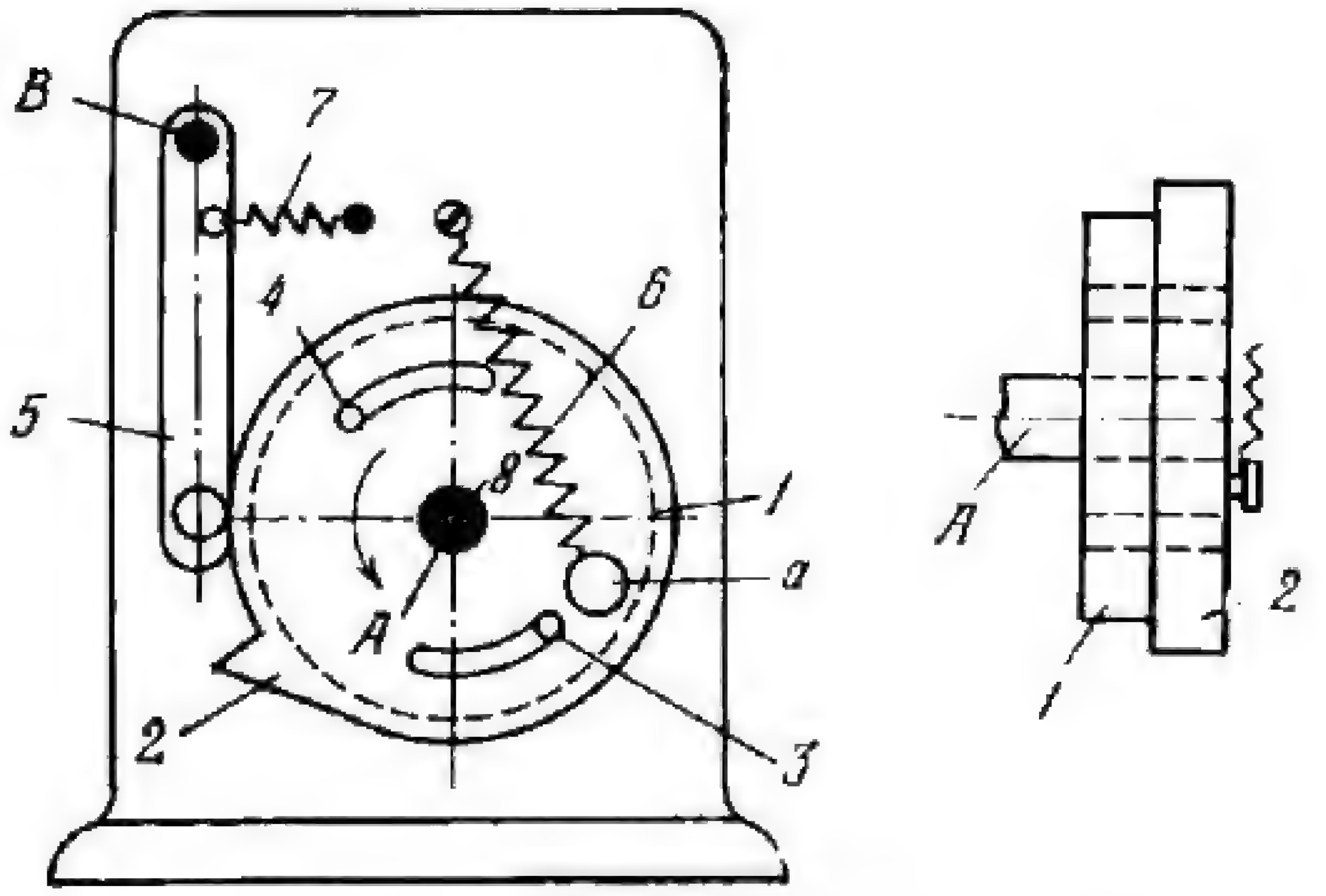
Driver *1* oscillates about fixed axis *A* and carries roller *3* which rolls and slides along helical groove *a* of cam *2*. Cam *2* oscillates about fixed axis *B-B*. Transmission of oscillation from driver *1* to cam *2* is possible only with a sufficiently large helix angle of groove *a*. A full cycle corresponds to two revolutions of cam *2* in one direction and two revolutions in the other direction. The mechanism can be employed for switching over motion.

3103 CAM-TYPE SWITCH MECHANISM — SmC SE



Disk *1* rotates about fixed axis *A*. Rigidly attached to disk *1* is cam dog *2*. Followers *4* slide in the holes of fixed housing *a*. When disk *1* rotates, cam dog *2* actuates followers *4* which consecutively close spring contacts *3*.

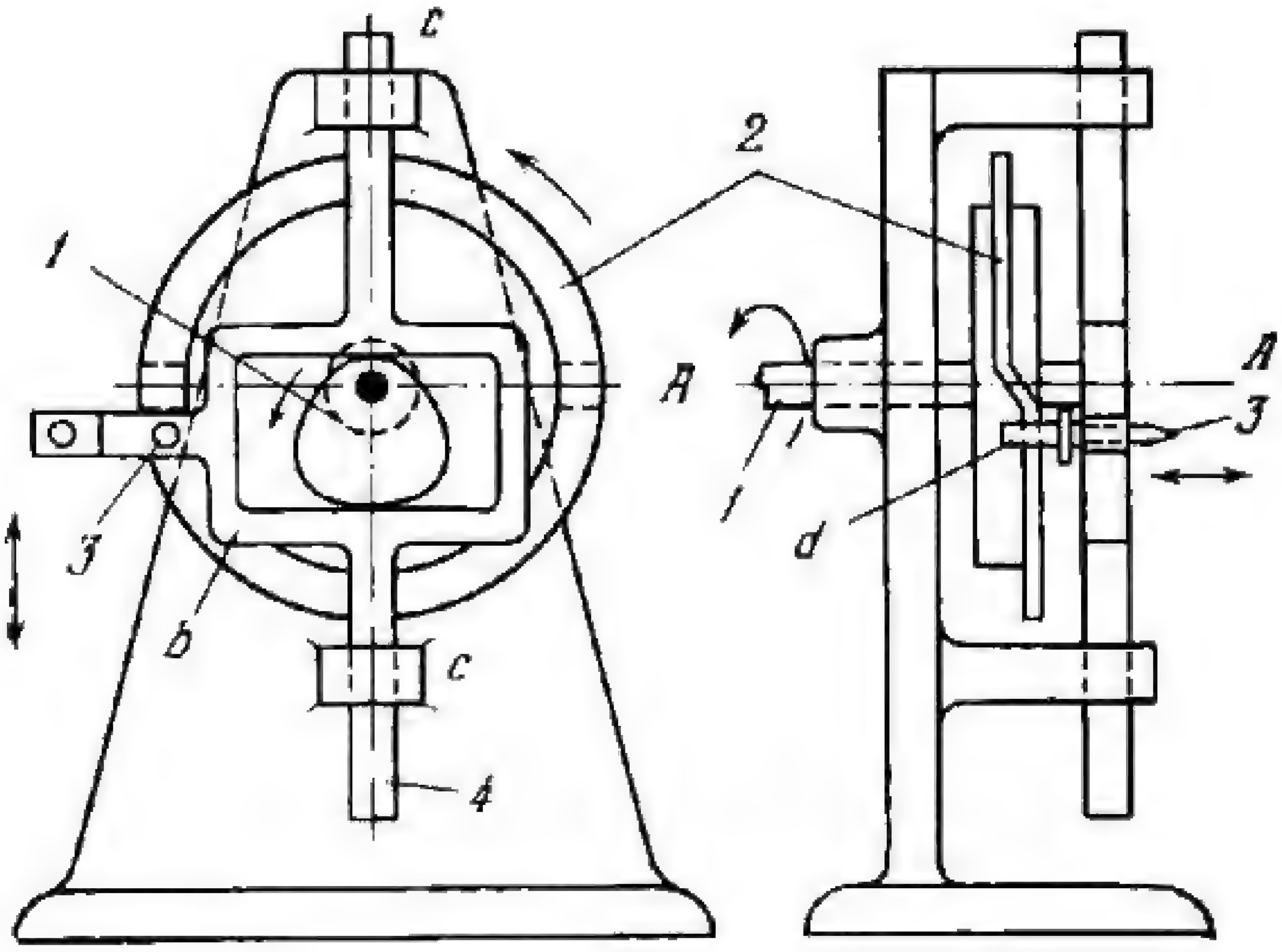
3104	CAM-TYPE ENGAGING AND DISENGAGING MECHANISM	SmC SE



Flange 1 (shown at the left by a dash line) is keyed to shaft 8 which rotates about fixed axis A of the machine. Cam 2 rotates freely on shaft 8 but its motion is limited by pins 3 and 4, press-fitted in flange 1 and sliding along concentric slots of cam 2. One end of spring 6 is attached to pin a of cam 2 and the other end to the base. When shaft 8 rotates counterclockwise, flange 1 rotates cam 2 in the same direction. When the projection of cam 2 deflects follower 5 to the left about fixed axis B, the machine is switched off and the shaft 8 stops. At this time, pin a is in its lowest position, corresponding to maximum tensioning of spring 6. Then spring 6 begins to contract and turns cam 2 further counterclockwise. At this, follower 5 is swung to the right by spring 7 and the machine is switched on again.

5. OPERATING CLAW MECHANISMS OF MOTION PICTURE CAMERAS (3105 through 3112)

3105	CONSTANT-BREADTH AND RIDGE CAM SPATIAL OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA	SmC OC

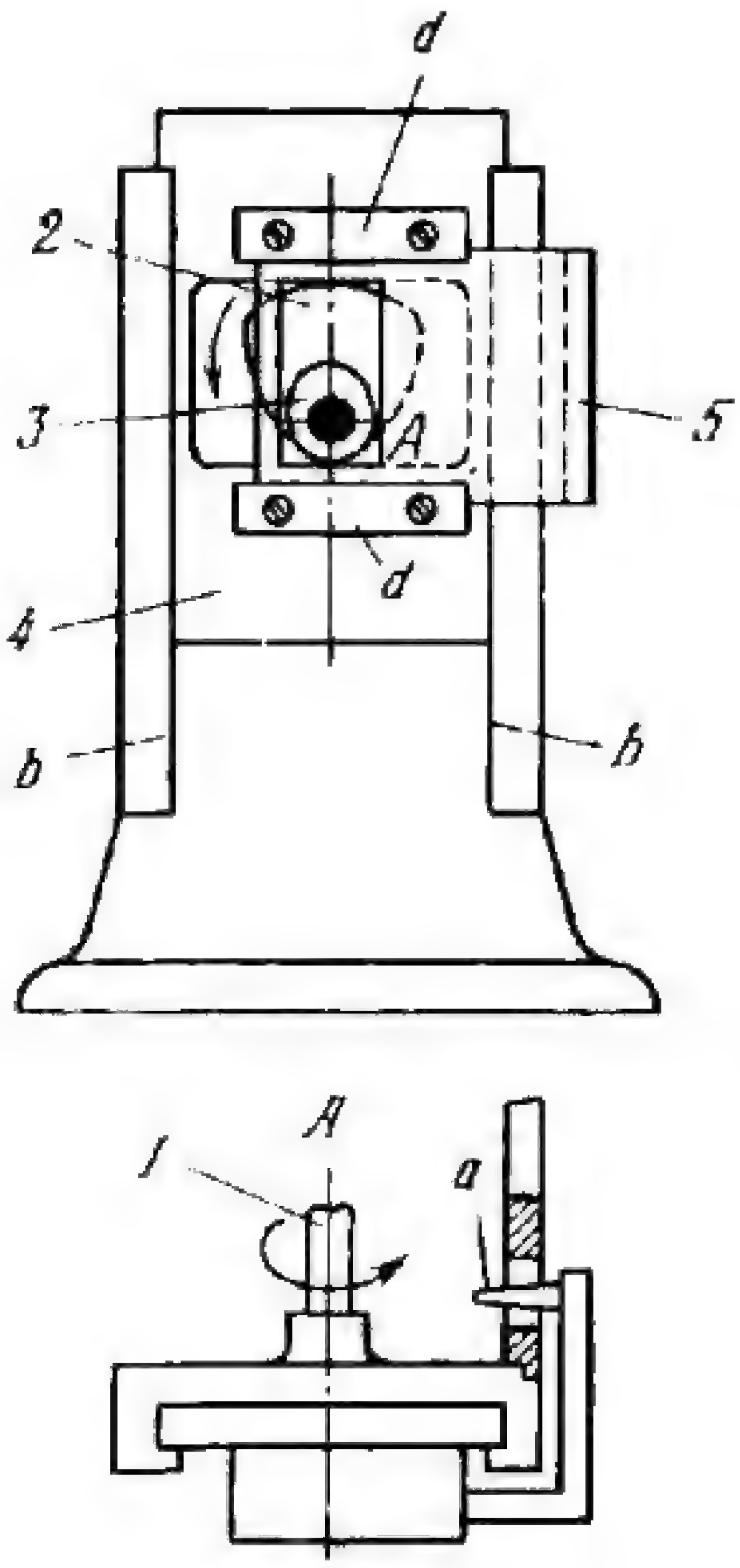


Rigidly attached constant-breadth cam *1* and cylinder ridge cam *2* rotate about fixed axis *A-A*. Follower *4* reciprocates in fixed guides *c-c*. Cam *1* is confined between the flat horizontal faces of yoke *b* of follower *4*. The sums of all the opposing radius vectors of cam *1* are constant and equal to the distance between the faces of yoke *b*. The profiled ridge of cam *2* slides in slot *d* of pin *3* which slides in a hole in follower *4* and reciprocates together with the follower. When cams *1* and *2* rotate, the latter inserts the claw of pin *3* into a perforation of the film which is then advanced by follower *4*. After this, cam *2* withdraws pin *3* from the perforation.

3106

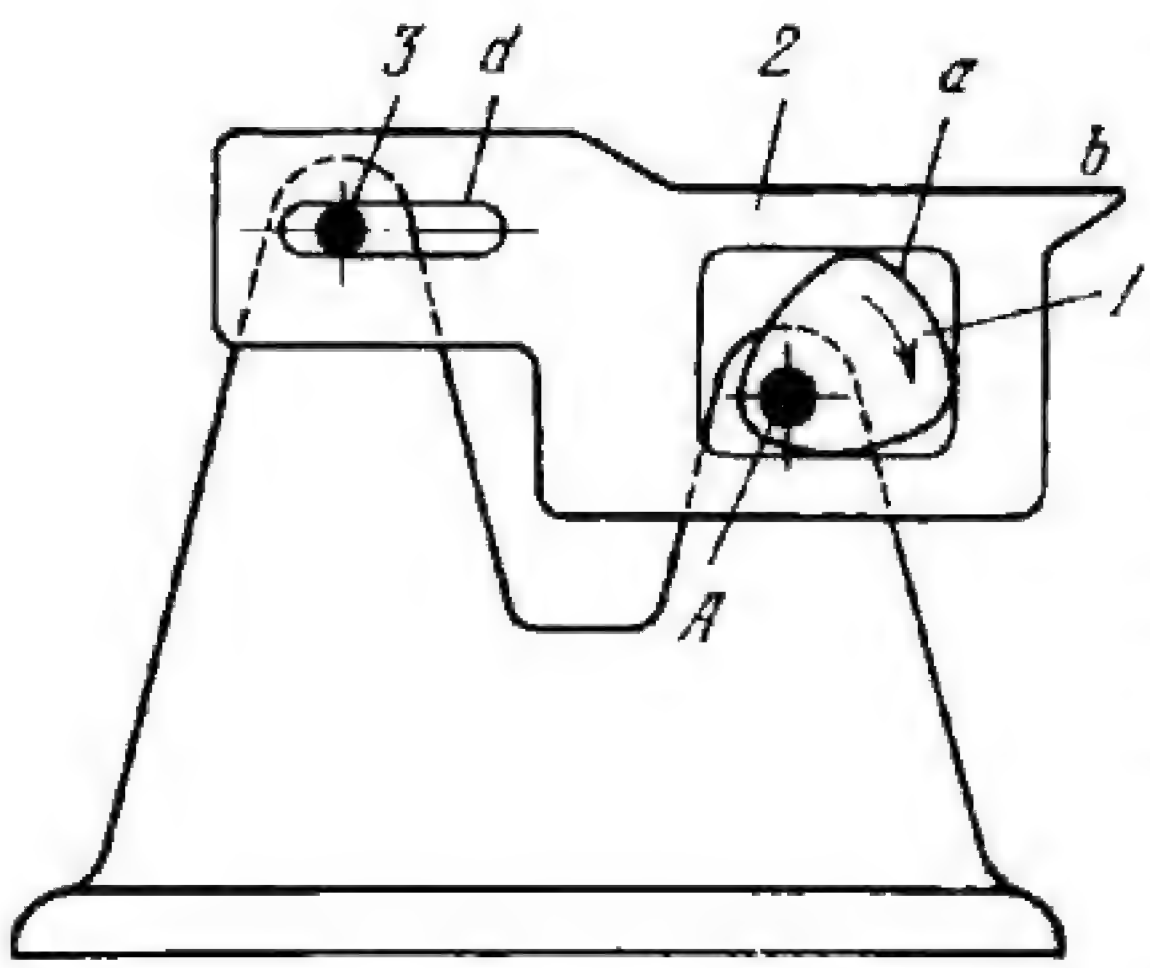
CAM-TYPE OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA

SmC
OC



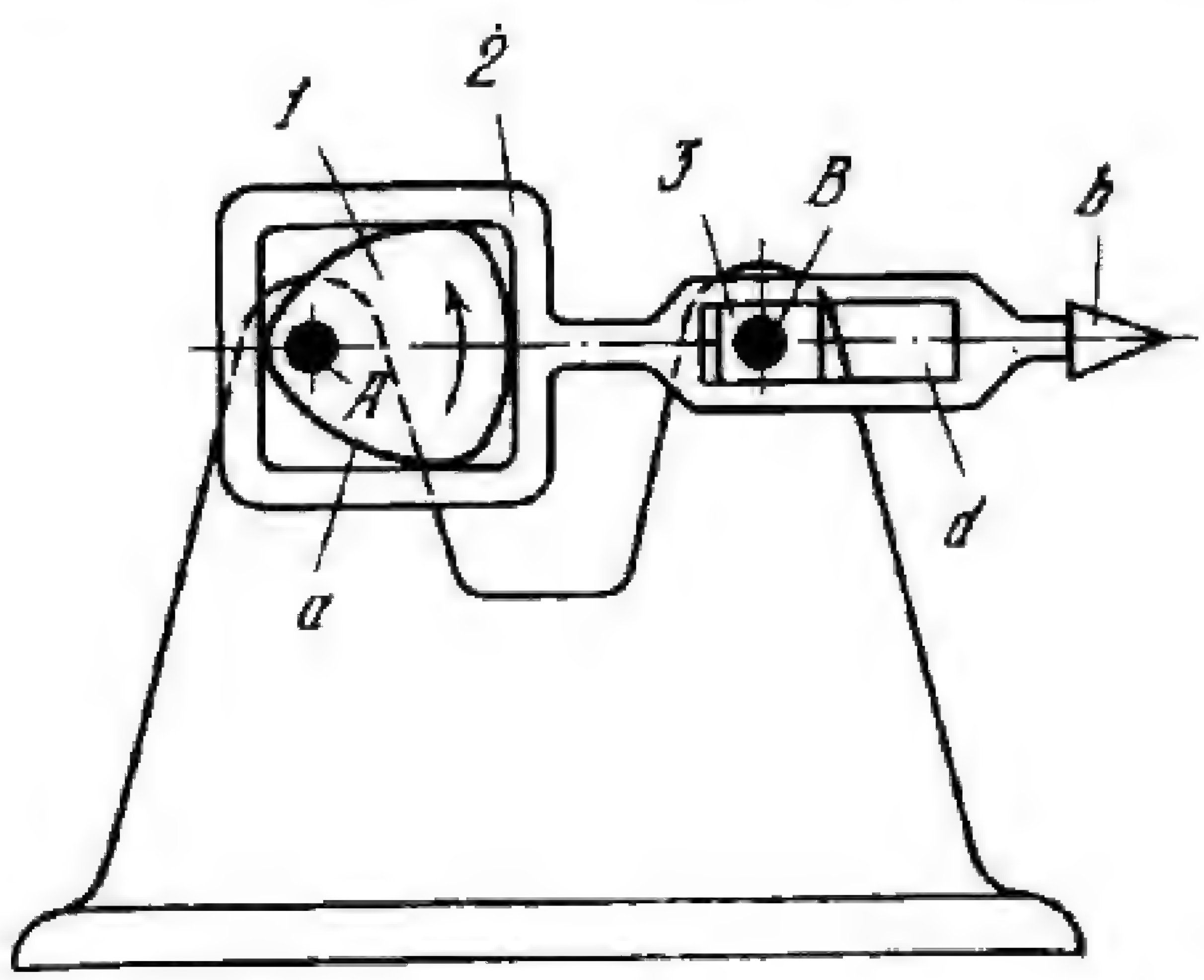
Three-lobe constant-breadth cam *2* and eccentric cam *3* are keyed to shaft *1* and rotate about fixed axis *A*. Slide *4* reciprocates vertically in fixed guides *b-b* of the base and is operated by cam *2*. Slide *5*, carrying operating claws *a*, reciprocates horizontally in guides *d-d* of slide *4* and is operated by cam *3*. When shaft *1* rotates, cam *3* inserts claws *a* into perforations of the film and then, after the film is advanced by cam *2*, withdraws the claws from the perforations.

3107	THREE-LINK CAM-TYPE OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH A PIN IN AN OFFSET SLOT	SmC OC



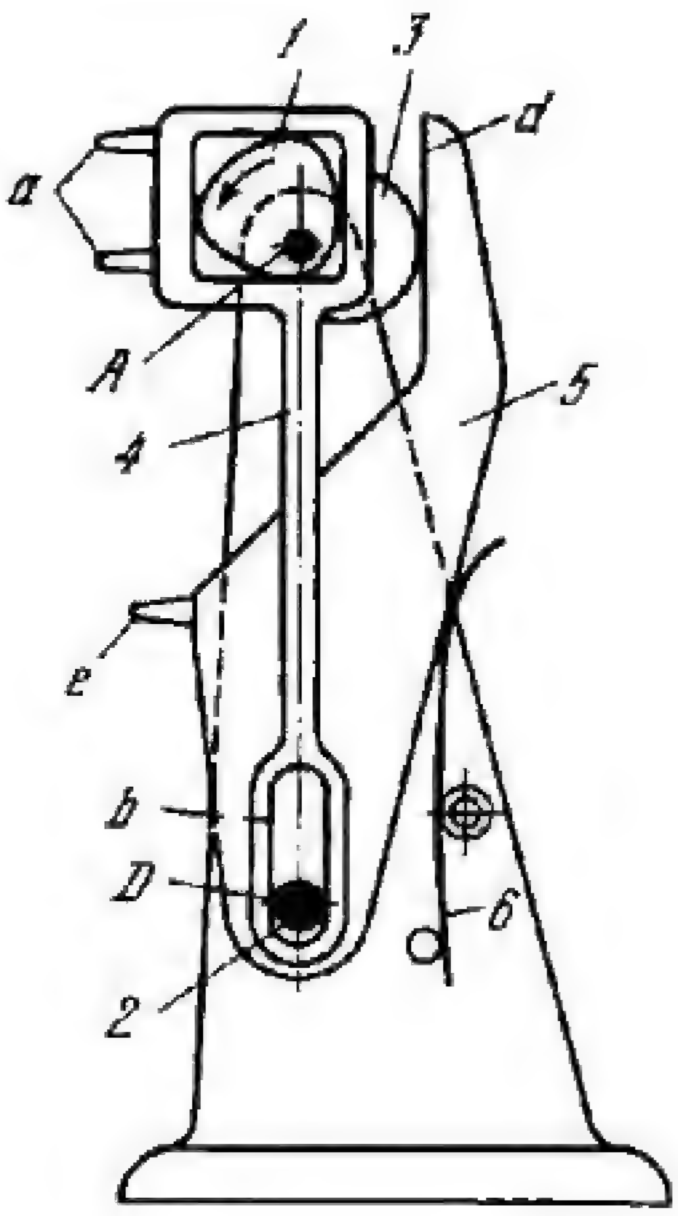
Three-lobe constant-breadth cam *1* rotates about fixed axis *A*. Contour *a* of cam *1* is enclosed by a rectangular opening of follower *2* which has claw *b*. Follower *2* has straight slot *d* whose axis does not pass through point *A* and which slides along fixed pin *3*. When cam *1* rotates, follower *2* has a complex motion in which claw *b* is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3108	FOUR-LINK CAM-TYPE OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH A SLOTTED LINK	SmC OC



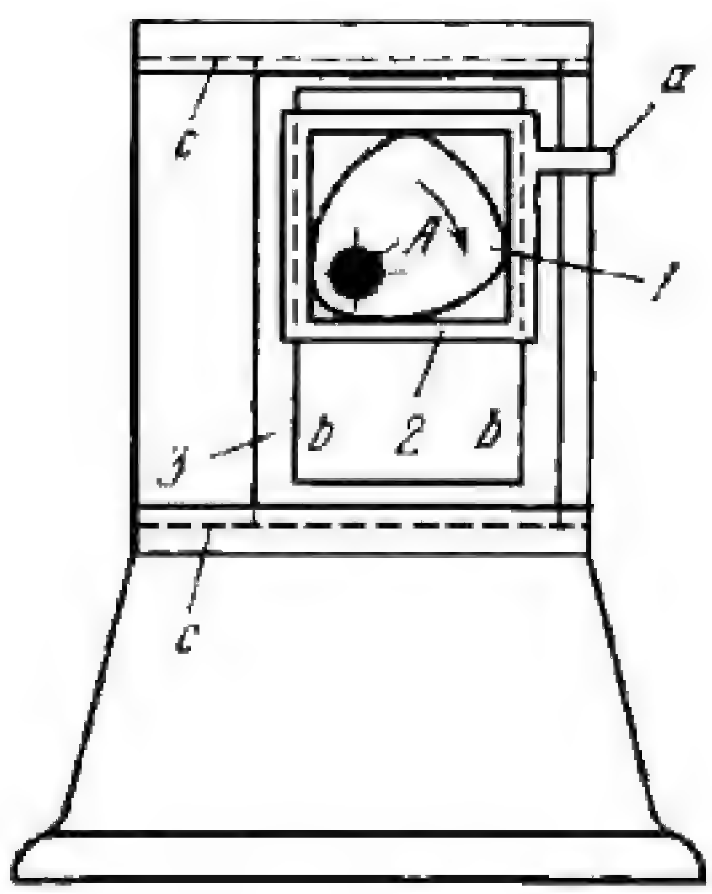
Three-lobe constant-breadth cam *1* rotates about fixed axis *A*. Contour *a* of cam *1* is enclosed by a square opening of follower *2* which has claw *b* and straight slot *d*. Slot *d* slides along member *3* which turns about fixed axis *B*. When cam *1* rotates, follower *2* has a complex motion in which claw *b* is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3109	**FOUR-LINK CAM-TYPE OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH A ROCKER ARM**	SmC OC



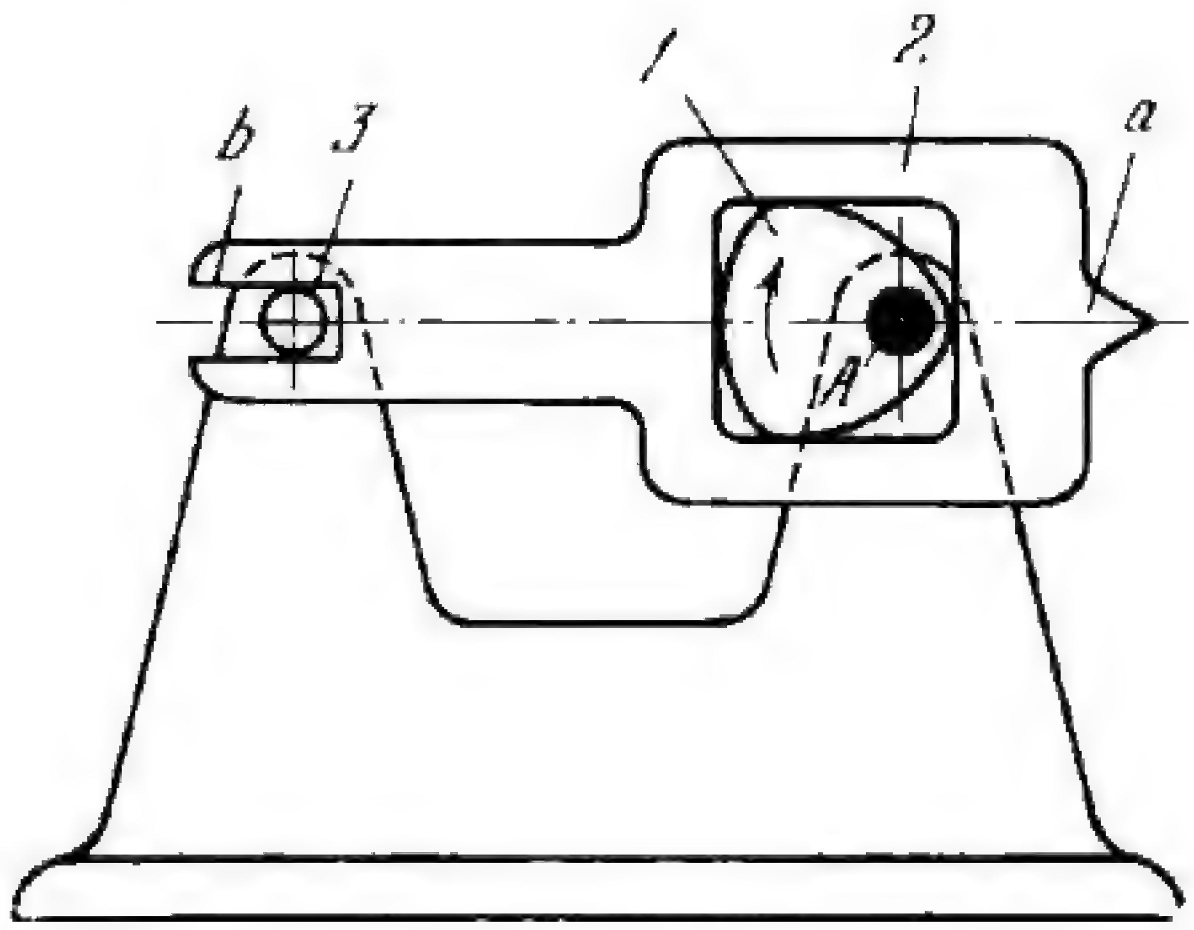
Three-lobe constant-breadth cam *1* and round eccentric cam *3* are rigidly attached together and rotate about fixed axis *A*. The contour of cam *1* is enclosed by the square opening of follower *4* which has slot *b* sliding along fixed pin *2*. Cam *3* acts on flat surface *d* of rocker arm (follower) *5* which oscillates about fixed axis *D* of pin *2*. Follower *4* has two claws *a* and rocker arm *5* has claw *e*. When cams *1* and *3* rotate, follower *4* has a complex motion in which claws *a* are inserted into perforations of the film, advance the film and are withdrawn from the perforations. After the film has been advanced, claw *e* of rocker arm *5* is inserted into a perforation to hold the film stationary until its next movement. Surface *d* of rocker arm *5* is held in contact with cam *3* by flat spring *6*.

3110	**FOUR-LINK CAM-TYPE DOUBLE-SLIDE OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA**	SmC OC



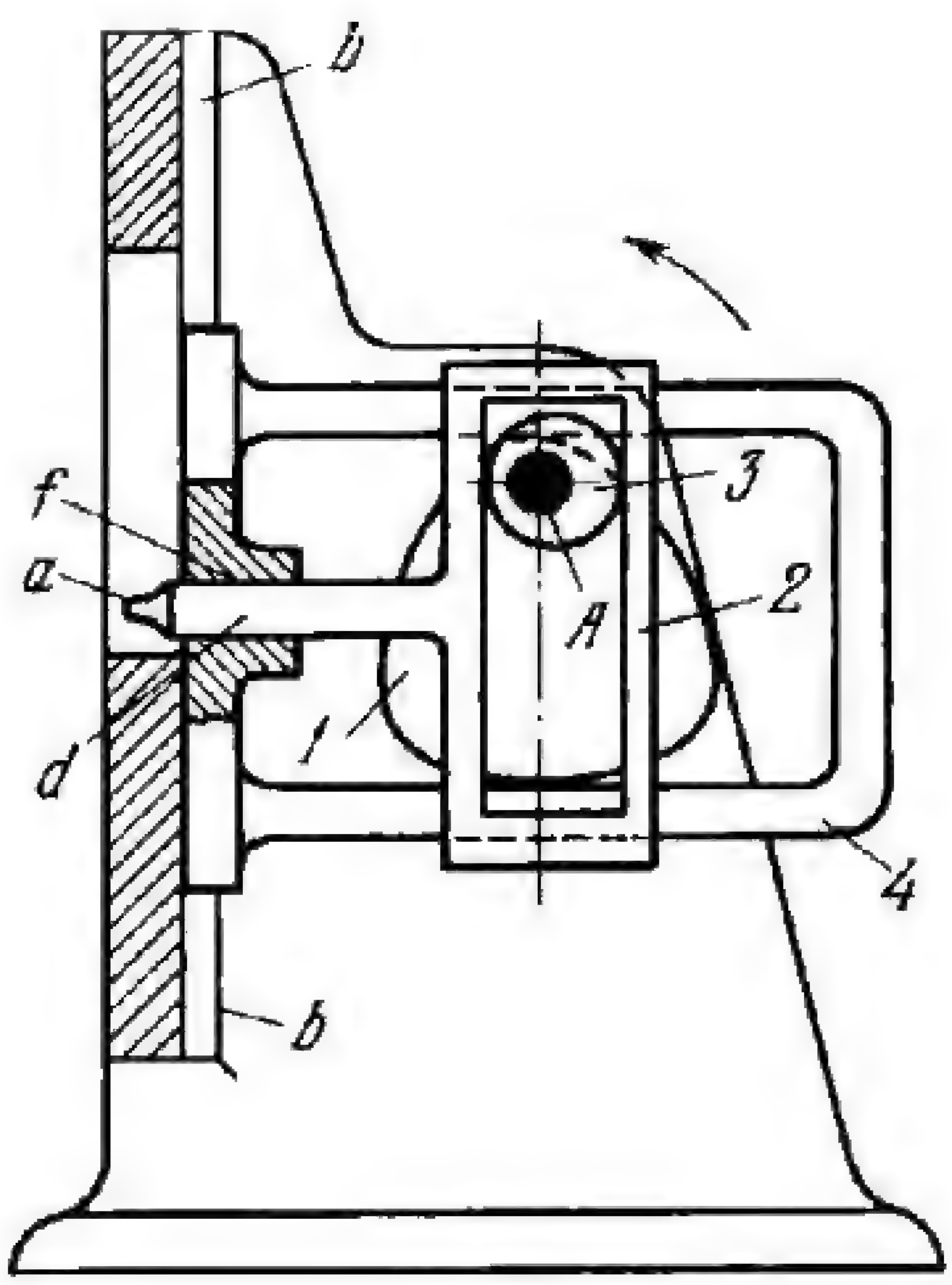
Three-lobe constant-breadth cam *1* is enclosed by the square opening of slide *2* which reciprocates vertically along guides *b-b* of slide *3* and has claw *a*. Slide *3* reciprocates horizontally along fixed guides *c*. When cam *1* rotates, claw *a* of slide *2* is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3111	THREE-LINK CAM-TYPE OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH A PIN IN AN ALIGNED SLOT	SmC OC



Three-lobe constant-breadth cam *1* rotates about fixed axis *A*. The contour of cam *1* is enclosed by the square opening in follower *2* which has claw *a*. Follower *2* has straight slot *b* whose axis passes through point *A* and which slides along fixed pin *3*. When cam *1* rotates, follower *2* has a complex motion in which claw *a* is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3112	FOUR-LINK CAM-TYPE DOUBLE-SLIDE OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA	SmC OC



Three-lobe constant-breadth cam *1* and round eccentric constant-breadth cam *3* are rigidly attached together and rotate about fixed axis *A*. The contour of cam *1* is enclosed by the flat faces of slide *4* which reciprocates vertically along fixed guides *b*-*b*. The contour of cam *3* is enclosed by the flat faces of slide *2* which has pin *d* that reciprocates in guide *f* of slide *4* and has claw *a*. When cams *1* and *3* rotate, claw *a* is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

6. MECHANISMS OF VIBRATING MACHINES AND DEVICES (3113 and 3114)

3113	THREE-LINK VIBRATING-FOLLOWER PLATE CAM MECHANISM	SmC VM

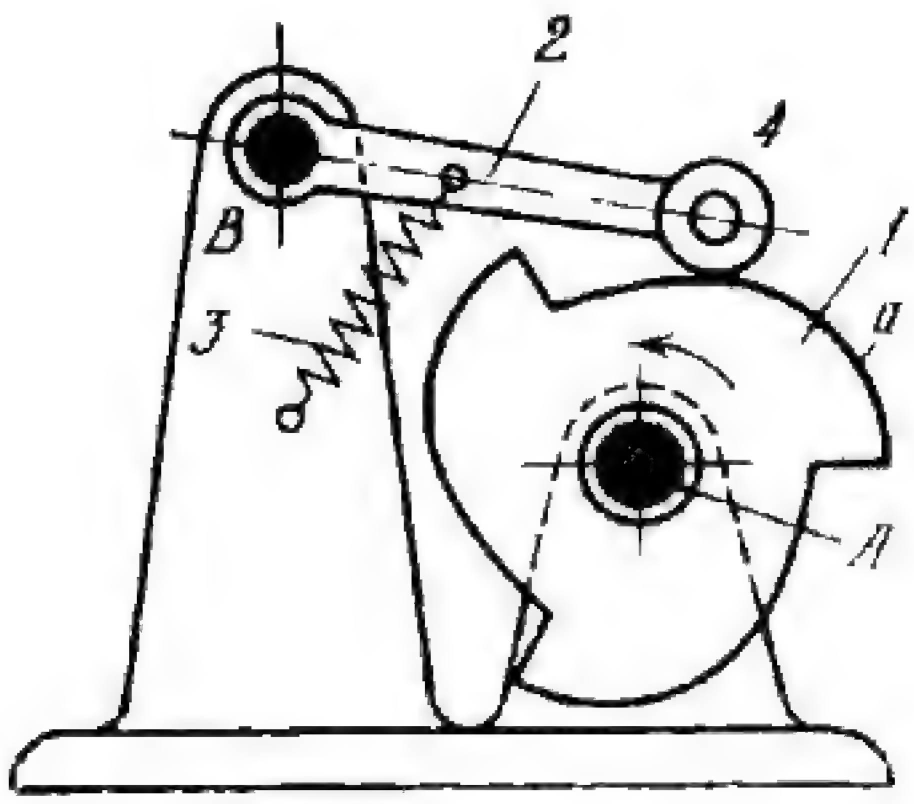


Plate cam *1* rotates counterclockwise about fixed axis *A* and has three profiled lobes *a*. Follower *2* oscillates about fixed axis *B* and carries roller *4* which rolls along lobes *a* of cam *1*. Owing to the contour of lobes *a*, roller *4* drops after each rise, imparting vibrational motion to follower *2*. Roller *4* is held in contact with cam *1* by spring *3*.

3114	THREE-LINK CAM-TYPE VIBRATOR MECHANISM	SmC VM

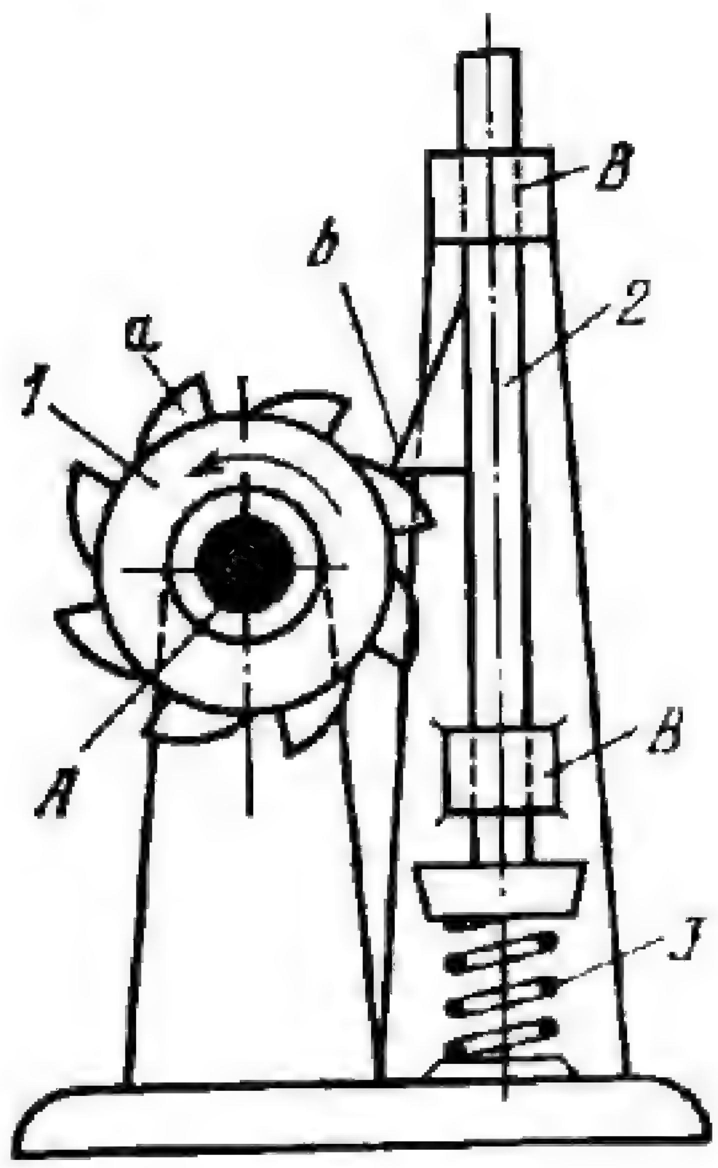
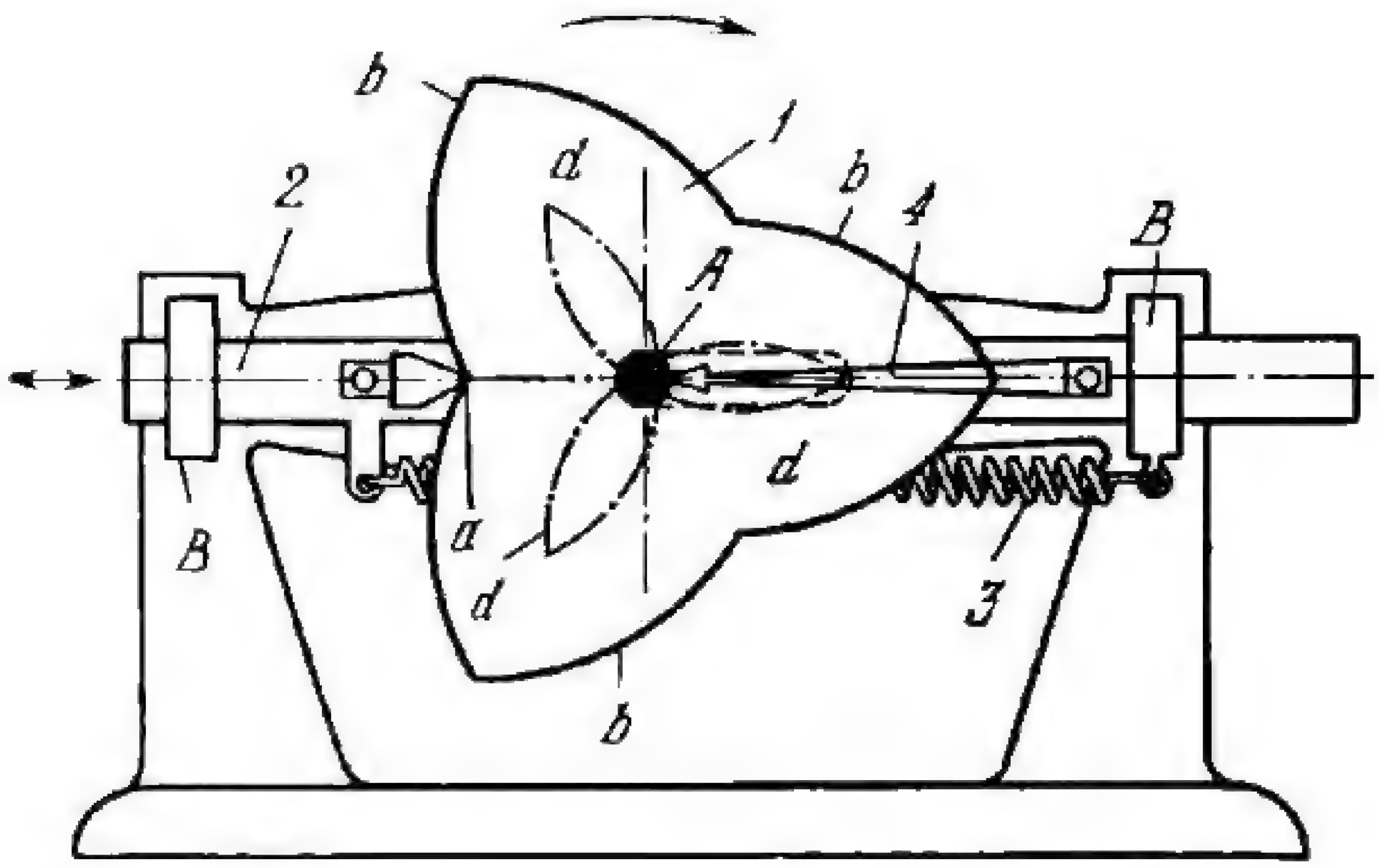


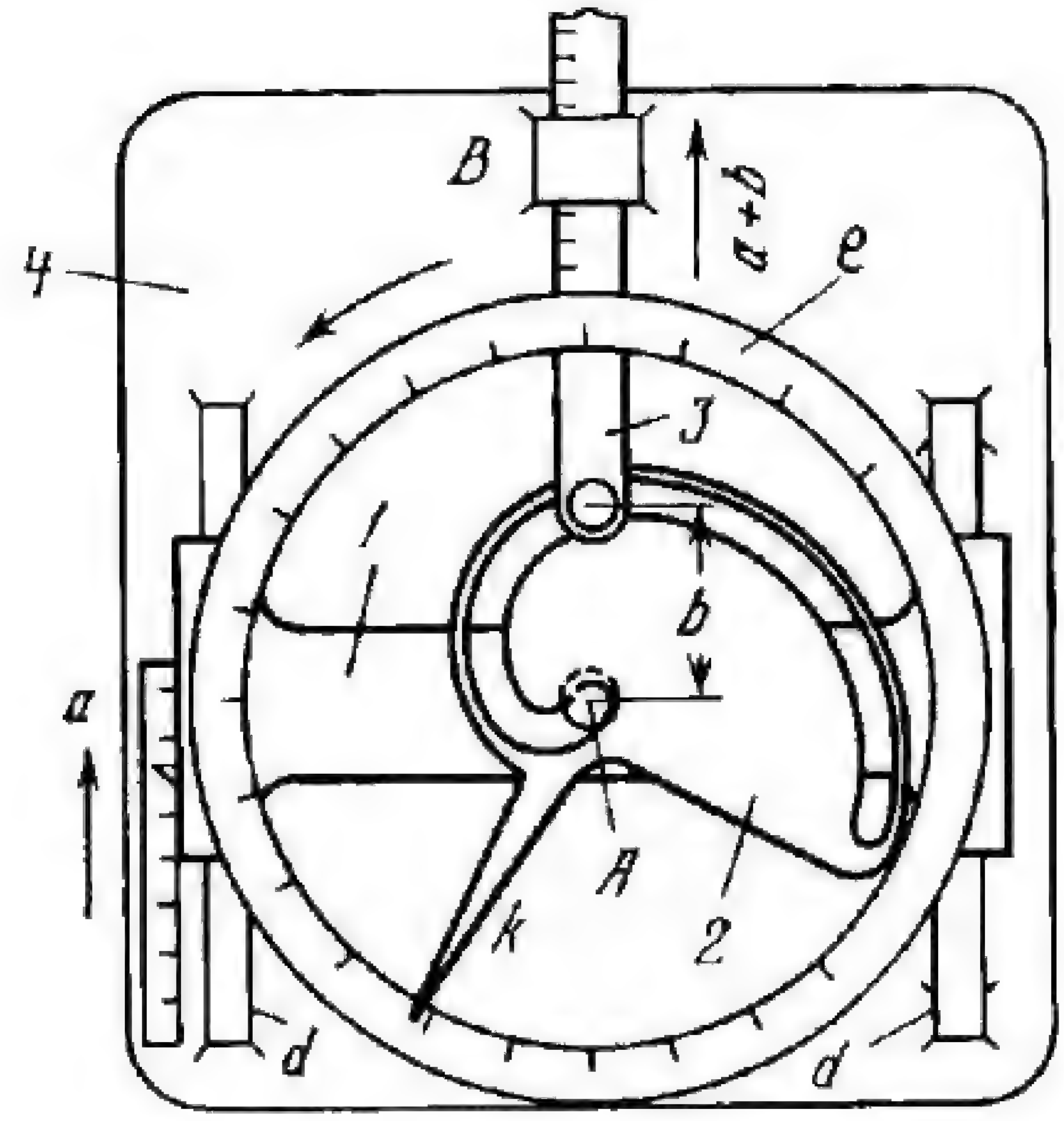
Plate cam *1* rotates counterclockwise about fixed axis *A* and has profiled lobes *a*. Follower *2* reciprocates in fixed guides *B-B* and has projection *b* which engages lobes *a* of cam *1*, raising the follower. When a lobe *a* disengages projection *b*, follower *2* drops, compressing spring *3*. In its downstroke, projection *b* engages the next lobe *a* and follower *2* is raised again. Thus, when cam *1* rotates continuously, follower *2* has a vibrational motion.

3115	THREE-LINK CAM-TYPE MECHANISM FOR TRACING THREE-LEAFED ROSES	SmC Ge



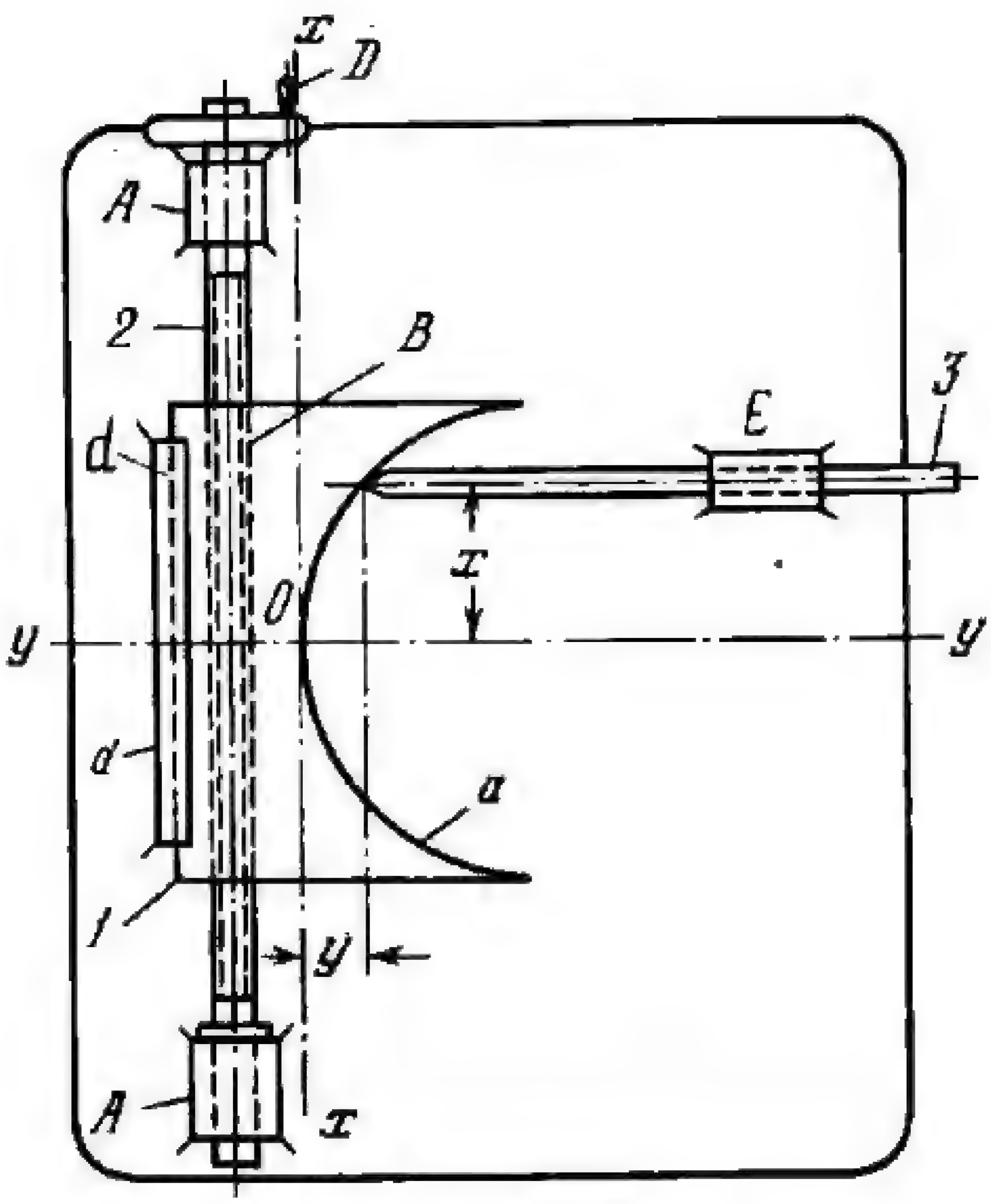
Cam *1* rotates about fixed axis *A*. Follower *2* reciprocates in fixed guides *B*-*B* and carries knife-edge *a* which slides along contour *b* of cam *1*. Rigidly attached to follower *2* is pointer *4* whose tip coincides with point *A* when follower *2* is in its extreme right-hand position. The contour (working surface) of cam *1* is designed so that the tip of pointer *4* describes a three-leafed rose when cam *1* rotates. Knife-edge *a* is held in contact with cam *1* by spring *3*.

3116	FOUR-LINK CAM-TYPE DIFFERENTIAL ADDING MECHANISM	SmC MO



Slide *1* moves along fixed guides *d-d* and carries cam *2* which rotates about axis *A* of slide *1* and has hand *k*. Hand *k* indicates, on dial *e* of slide *1*, the angle of rotation of cam *2* which is proportional to the radius vector of the theoretical, or pitch, curve of cam *2*. Follower *3* slides in fixed guide *B* and carries a pin which slides along the profiled groove of cam *2*. Addends proportional to quantity *a* are entered by traversing slide *1* along guides *d-d*. Addends proportional to quantity *b* are entered by turning cam *2* about axis *A*. The sum $a + b$ is proportional to the displacement of follower *3*.

3117	CAM-TYPE POWER-FUNCTION MECHANISM	SmC MO



Cam *1* slides along fixed guides *d-d* and its working surface *a* is along a curve that satisfies the condition

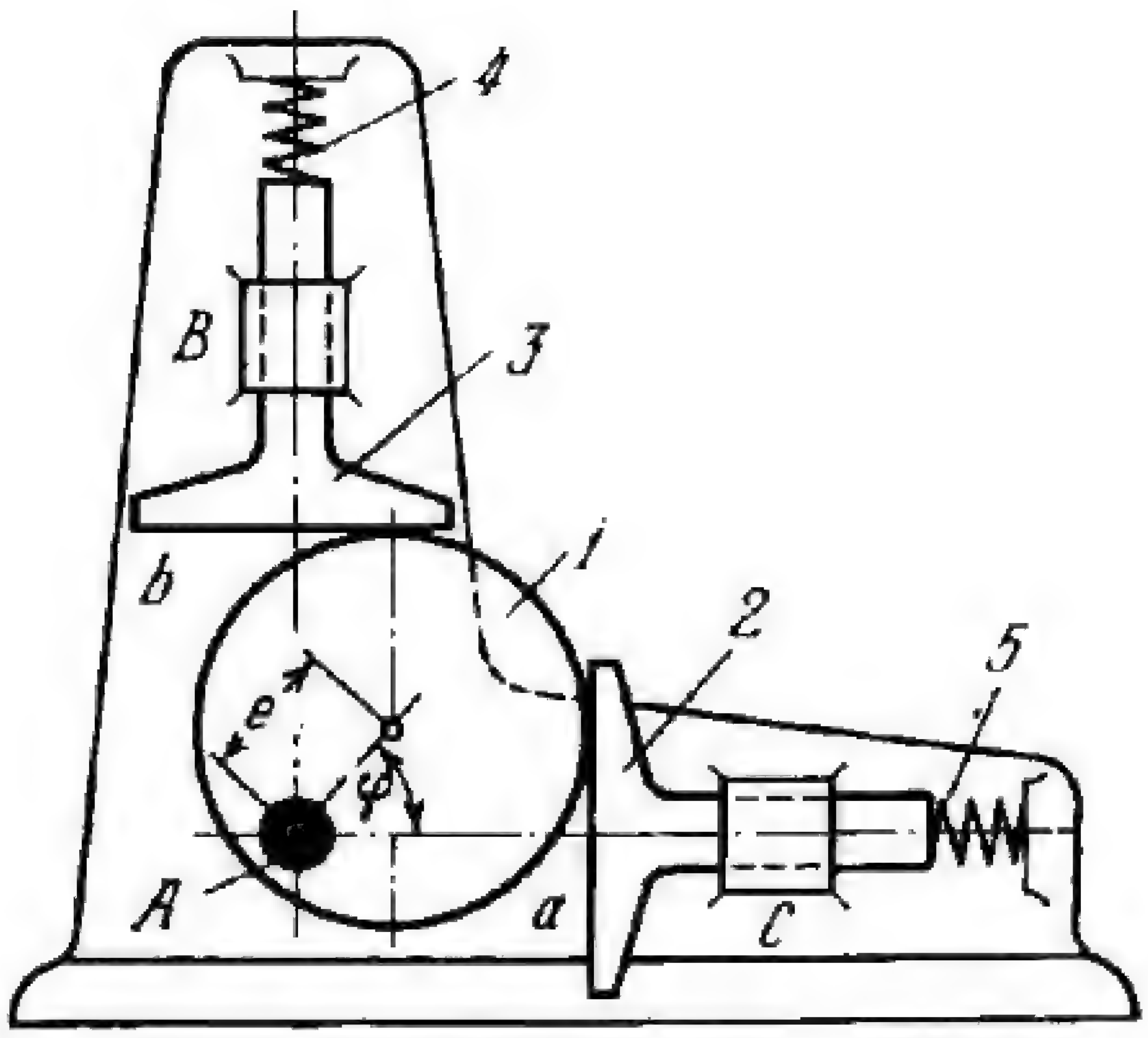
$$y = Cx^n$$

where C is a constant depending on the transmission angle. Screw *2* rotates in fixed bearings *A* and is connected by screw pair *B* to cam *1*. Follower *3* slides in fixed guide *E* and its pointed tip slides along working surface *a* of cam *1*. When handwheel *D* is turned through the angle φ, follower *3* is displaced by the distance y which is proportional to

$$y = C(\varphi r \tan\beta)^n$$

where r is the pitch radius of the thread of screw *2* and β is the helix angle of the thread.

3118	FOUR-LINK CAM-TYPE SINE AND COSINE GENERATOR	SmC MO



Cam *1*, a round eccentric, rotates about fixed axis *A*. Followers *2* and *3* reciprocate in fixed guides *C* and *B*, whose axes intersect at point *A* forming a right angle, and have flat faces *a* and *b*, perpendicular to the axes of motion of the followers, which slide along the contour of cam *1*. When cam *1* is turned, follower *2* is displaced a distance

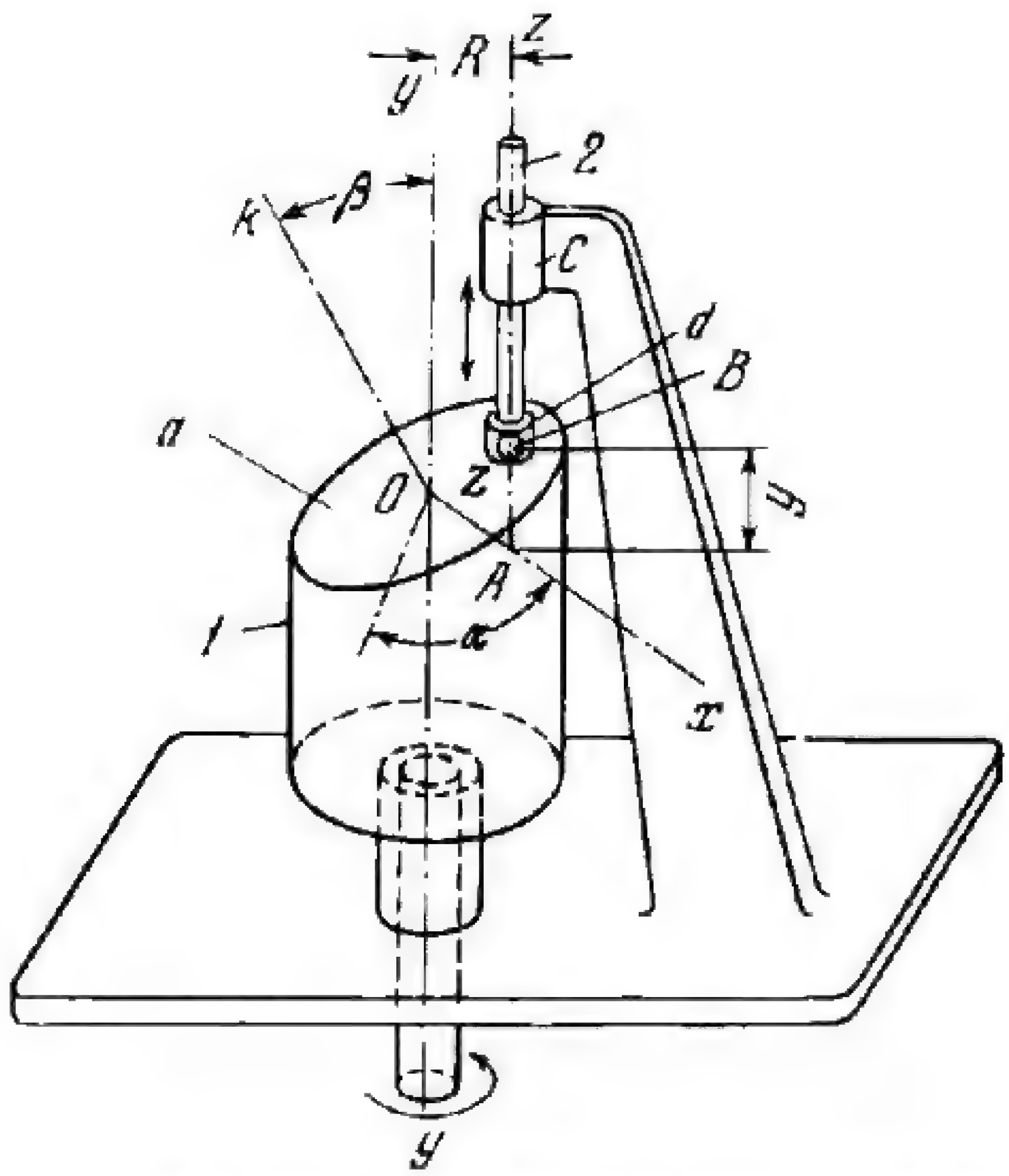
$$x = e \cos \varphi$$

and follower *3* a distance

$$y = e \sin \varphi$$

where e is the eccentricity and φ is the angle of rotation of cam *1*. Followers *3* and *2* are held in contact with cam *1* by springs *4* and *5*.

3119	THREE-LINK SPATIAL CAM-TYPE SINE GENERATOR	SmC MO

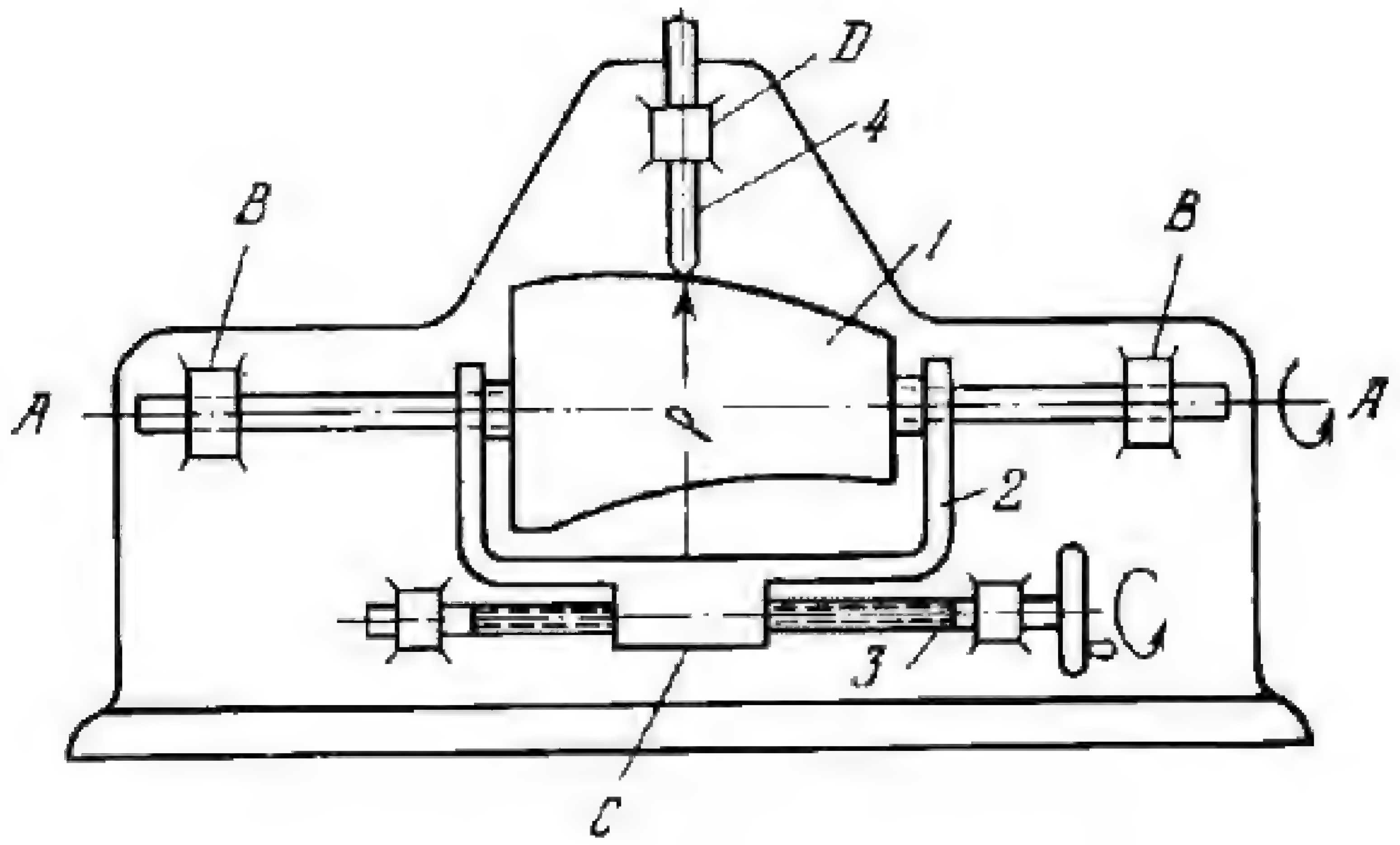


Side cam *1* rotates about fixed axis *y-y* and has plane working surface *a* whose normal *k* makes the angle β with axis *y-y*. Follower *2* slides in fixed guide *C* whose axis *z-z* is parallel to axis *y-y*. Follower *2* carries ball *B* in holder *d*. When cam *1* is turned through the angle α, the point of contact of ball *B* with surface *a* is displaced the distance

$$y = R \tan \beta \sin \alpha$$

where *R* is the distance between axes *y-y* and *z-z*. Thus, the displacement of follower *2* is proportional to the sine of angle α, the angle of rotation of cam *1*.

3120	**SPATIAL CONOID CAM MECHANISM FOR GENERATING FUNCTIONS OF TWO VARIABLES**	SmC MO

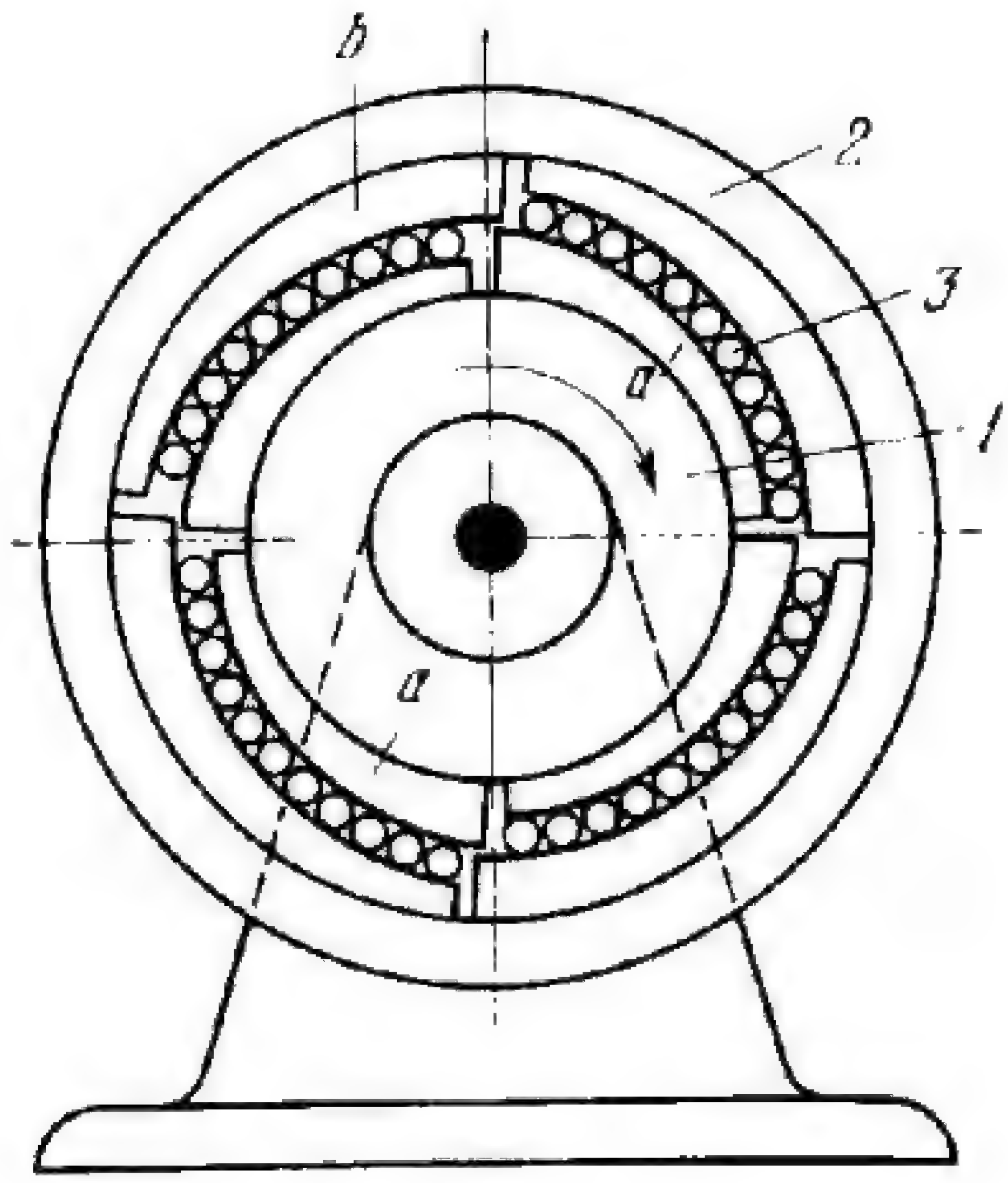


Conoid cam *1* rotates about fixed axis *A-A*. Carriage *2*, in which cam *1* rotates, is connected by screw pair *C* to screw *3*. Follower *4* slides in fixed guide *D* and its pointed tip slides along cam *1*. Carriage *2* with cam *1* can be traversed along axis *A-A* by turning screw *3*. The rotation of conoid cam *1* is proportional to one independent variable, for instance, x, and the travel of carriage *2* is proportional to the other independent variable, for instance, y. The displacement of follower *4* is proportional to a function of two independent variables. Thus

$$\rho = f(x, y).$$

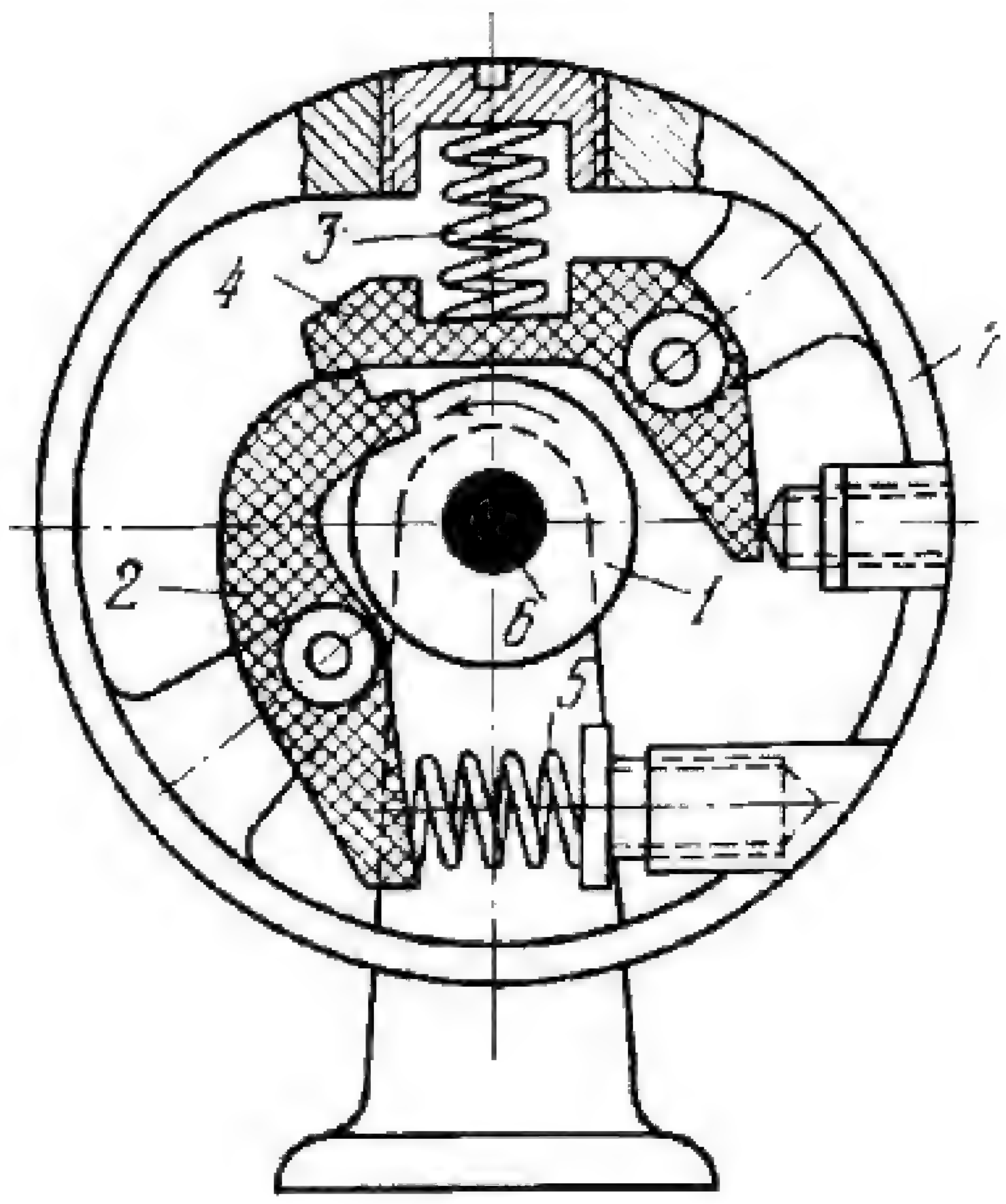
9. CLUTCH AND COUPLING MECHANISMS
(3121 through 3125)

3121	CAM-TYPE ROLLER COUPLING MECHANISM	SmC C



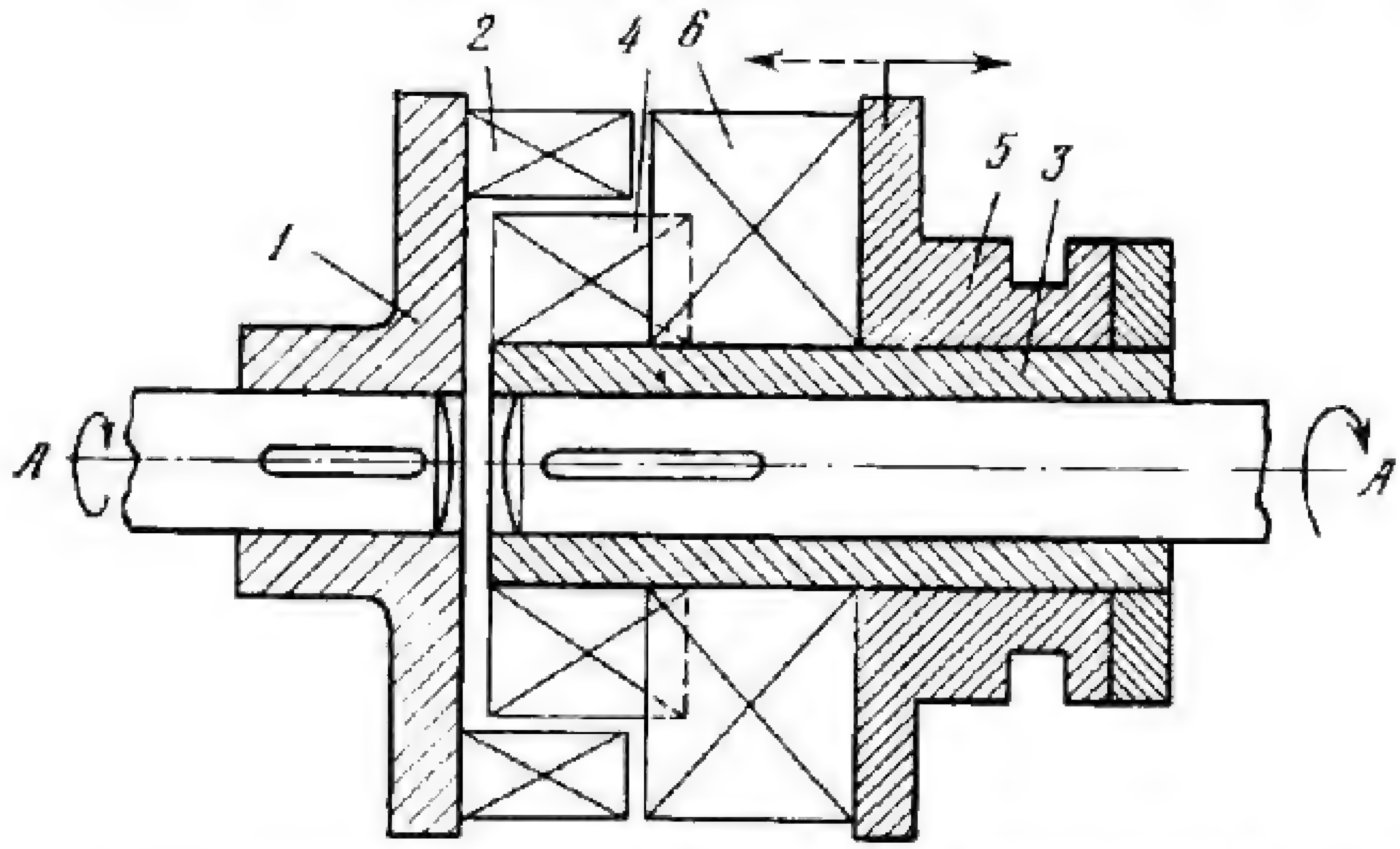
Driving and driven rings *1* and *2* have cam surfaces formed by circular wedge-shaped inserts *a* and *b* with rollers *3* between them. Since inserts *a* and *b* have cam surfaces along an Archimedean spiral, the load is uniformly distributed among all the rollers. Torque is transmitted by the action of rollers *3* on inserts *a* and *b*.

3122	CAM-TYPE SPEED-LIMITING CLUTCH MECHANISM	SmC C



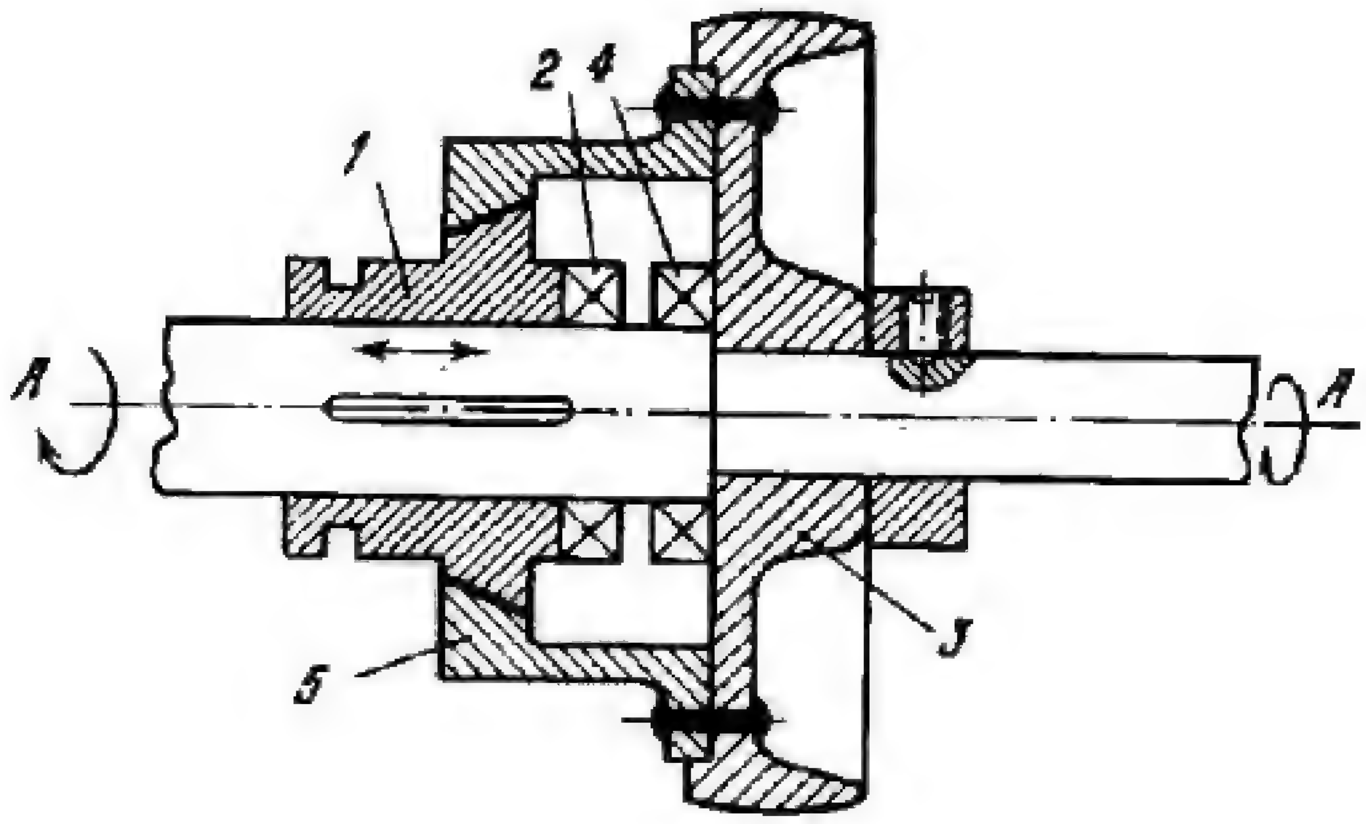
Torque is transmitted from shaft *6* to housing *7* by cam *1* which is keyed to shaft *6* and engages pawl *2*. When the speed of the clutch exceeds the preset value, the centrifugal force raises lever *4*, compressing spring *3*, and pawl *2*, compressing spring *5*, thereby disengaging the clutch. At this, the speed of housing *7* drops and springs *5* and *4* re-engage the clutch again.

3123	JAW-TYPE POSITIVE CLUTCH MECHANISM	SmC C



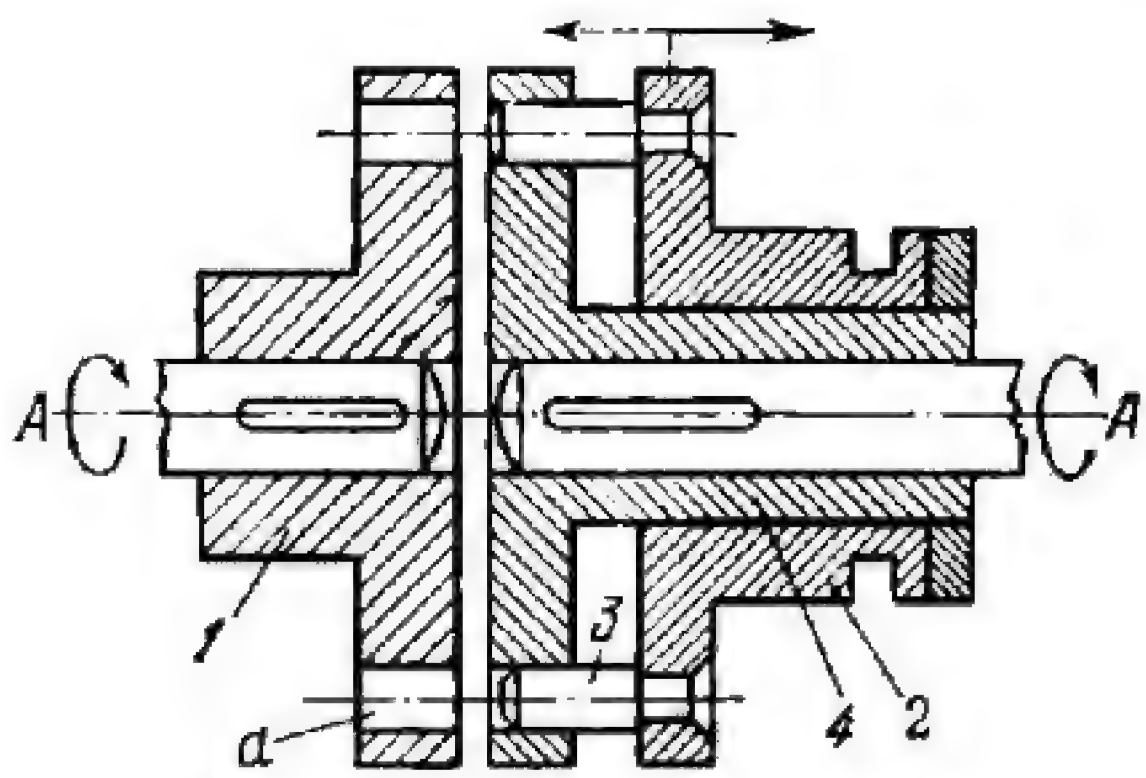
Disk *1* and sleeve *3* rotate about common fixed axis *A-A*. Engaging collar *5* slides on sleeve *3* along axis *A-A*. Jaws *2* are rigidly attached to disk *1* and jaws *4* to sleeve *3*. Sleeve *3* serves as a guide for collar *5* with jaws *6* which slide in the spaces between jaws *4*. To engage the clutch it is necessary to substantially reduce the speeds of the shafts and to shift collar *5* to the left.

3124	CONE AND JAW POSITIVE CLUTCH MECHANISM	SmC C



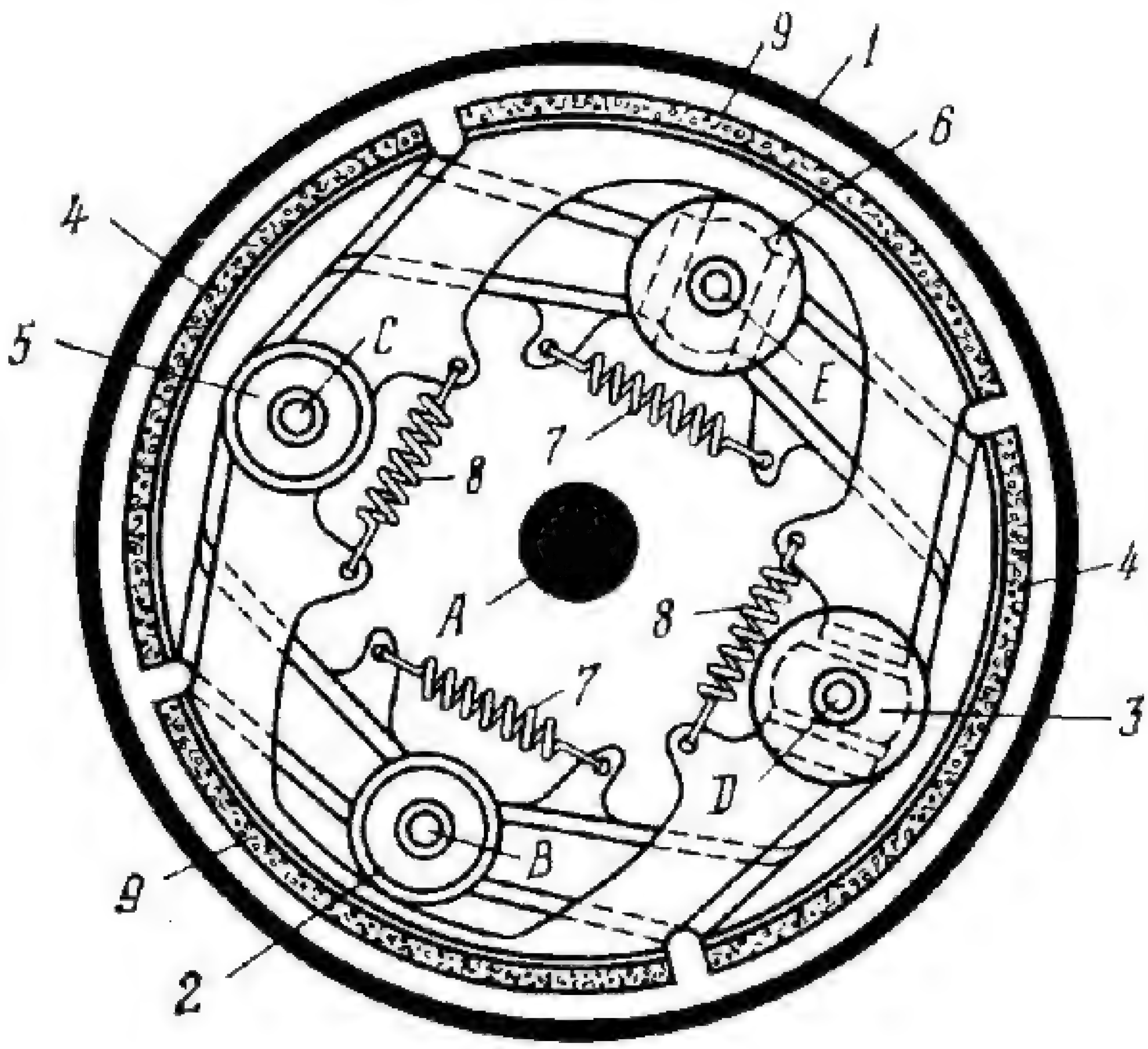
Pulley *3* and cone and jaw engaging collar *1* rotate about common fixed axis *A-A*. Collar *1* can slide on a feather key along axis *A-A* and has rigidly attached jaws *2*. Pulley *3* is integral with jaws *4* and is rigidly attached to cone member *5*. To engage the clutch, collar *1* is first shifted to the left to bring the conical surfaces of collar *1* and member *5* into contact and to equalize the speeds of the shaft and pulley. When they are approximately equal, collar *1* is shifted to the right to engage jaws *2* and *4*.

3125	PIN-TYPE POSITIVE CLUTCH MECHANISM	SmC C



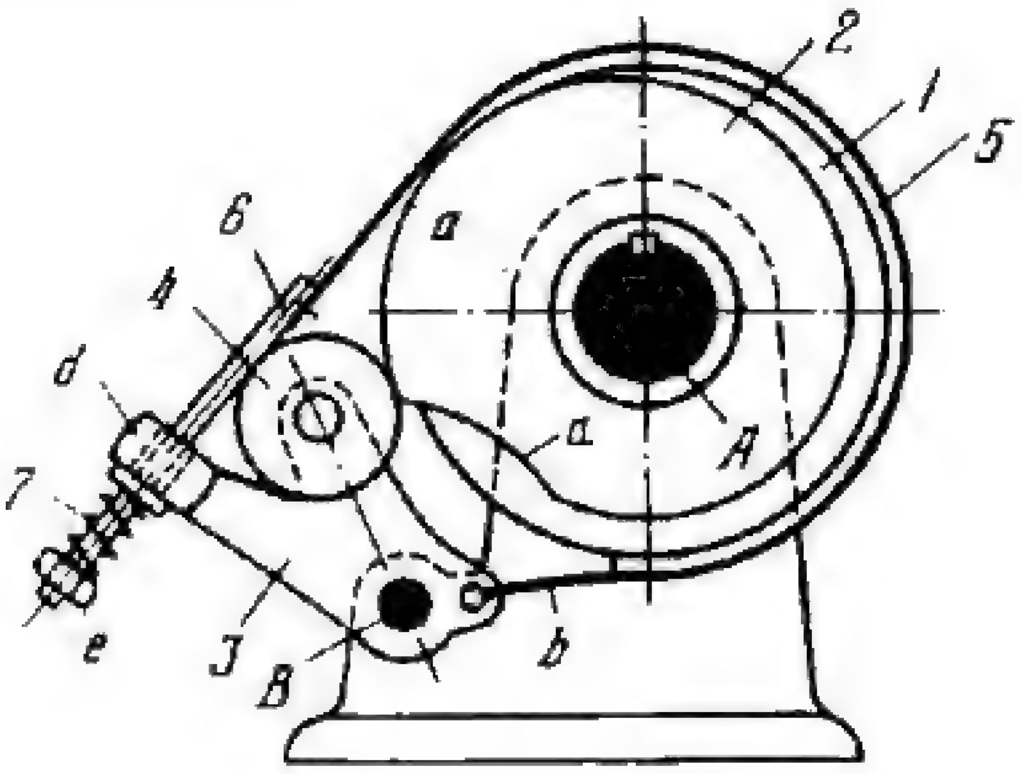
Disks *1* and *4* are keyed to their shafts and rotate about common fixed axis *A-A*. Engaging collar *2* can slide on the sleeve of disk *4* along axis *A-A*. Disk *1* has holes *a* for pins *3* which are press-fitted in collar *2* and pass through holes in disk *4*. The clutch is engaged at low speeds by shifting collar *2* to the left.

3126	CAM-TYPE DUPLEX CROSS-SHAPED BRAKE MECHANISM	SmC Br



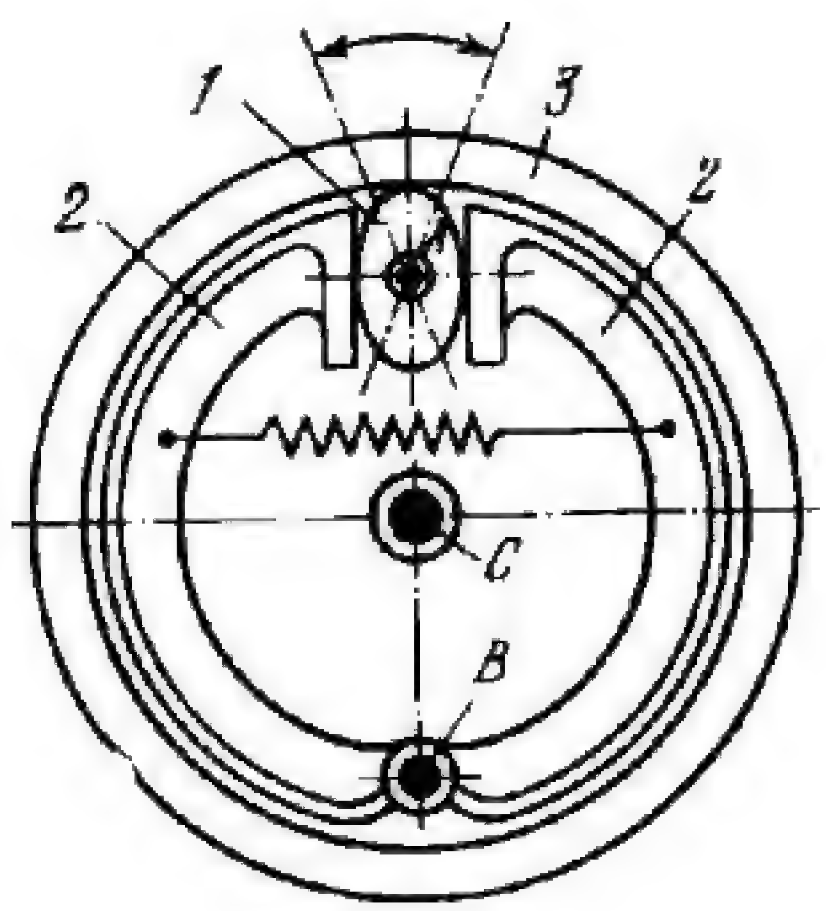
Drum *1* rotates about fixed axis *A*. Shoes *4* turn about axis *B* of the inner disk which rotates independently of drum *1*. Shoes *4* are forced against drum *1* by turning cam *6* about axis *E*. Shoes *9* turn about axis *C* of the inner disk and are forced against drum *1* by turning cam *3* about axis *D*. This applies the brake. When the brake is released, shoes *4* and *9* are retracted by springs *7* and *8*.

3127	CAM MECHANISM WITH A BRAKING DEVICE	SmC Br



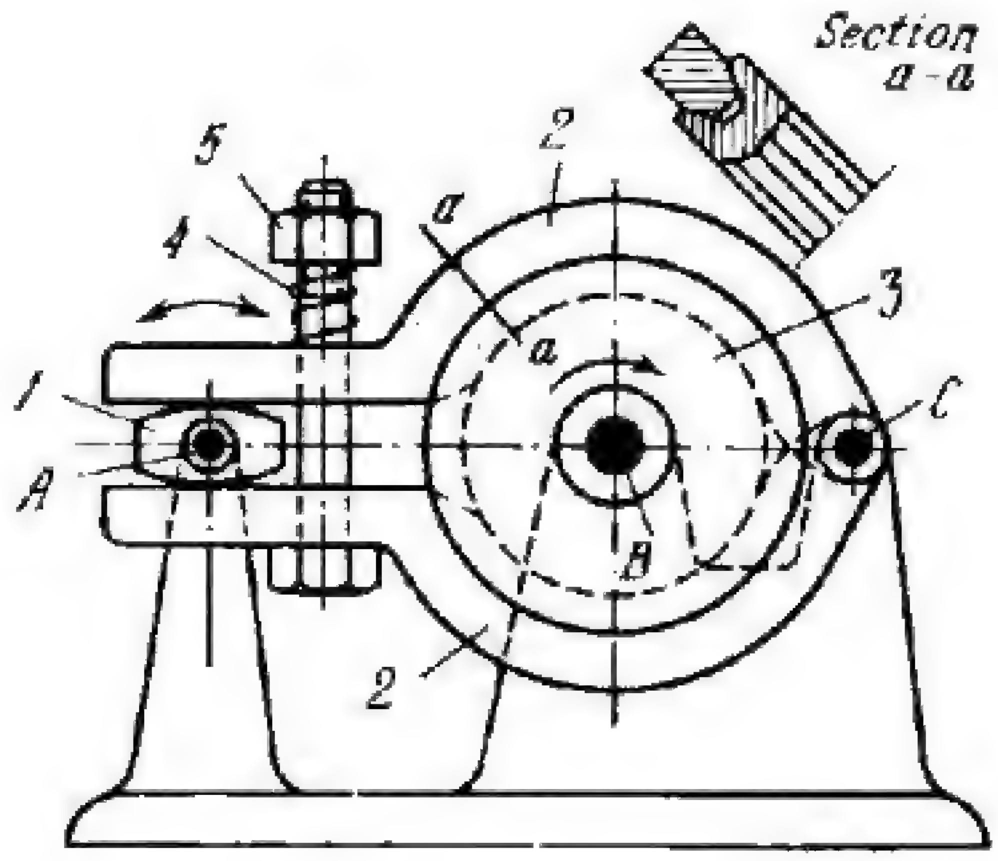
Cam *2* is rigidly attached to drum *1* and rotates about fixed axis *A*. Follower *3* turns about fixed axis *B* and carries roller *4* which rolls along working surface *a* of cam *2*. Flexible band *b* with lining *5* encircles drum *1*. Band *b* has at one end threaded rod *6* which passes through guide *d* of follower *3*. The other end of band *b* is secured to follower *3*. The tension of band *b* is adjusted with nut *e* which acts through spring *7*. The brake is applied at a certain point by the action of cam *2* on roller *4* and follower *3*, thereby tightening band *b*.

3128	CAM-APPLIED SHOE BRAKE MECHANISM	SmC Br



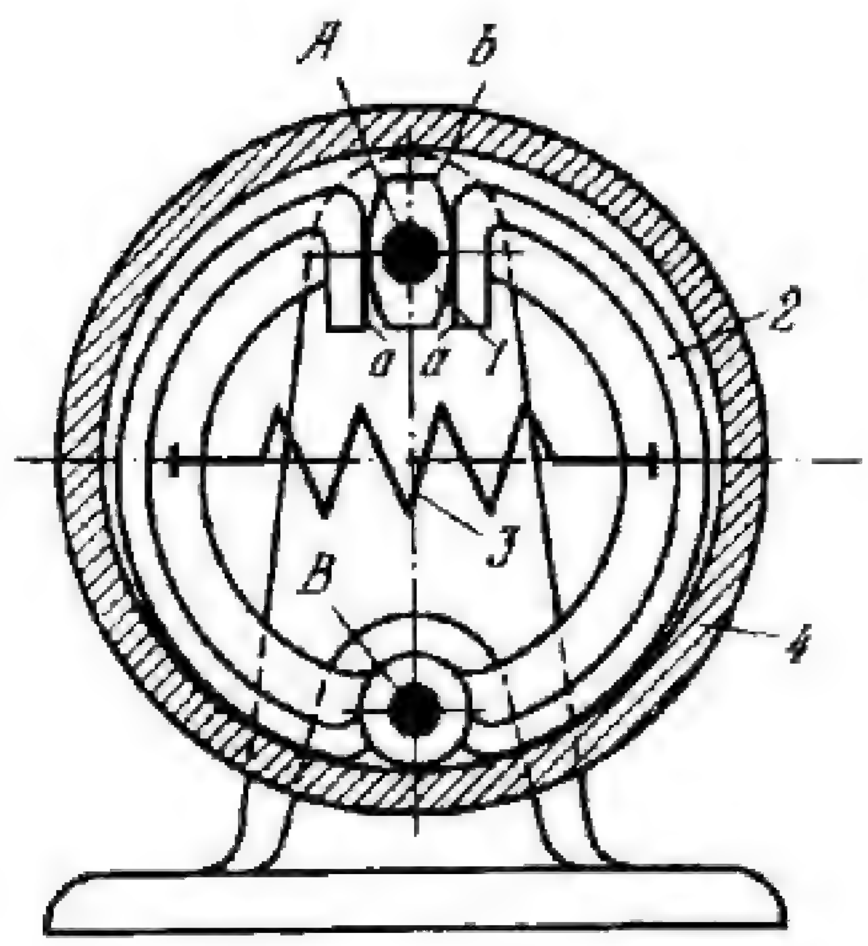
Wheel *3* rotates about fixed axis *C* and is braked by forcing shoes *2* against the internal surface of the drum on the wheel. Shoes *2* turn about fixed axis *B* and are forced against the drum by turning cam *1* about fixed axis *A*.

3129	CAM-OPERATED VEE-GROOVE BRAKE MECHANISM	SmC Br



Drum *3* rotates about fixed axis *B* and is braked by means of two vee-shaped shoes *2* which turn about fixed axis *C*. Shoes *2* are applied to the vee-groove drum by spring *4* which can be adjusted by nut *5*. The shoes are spread to release the brake by turning cam *1* about fixed axis *A*.

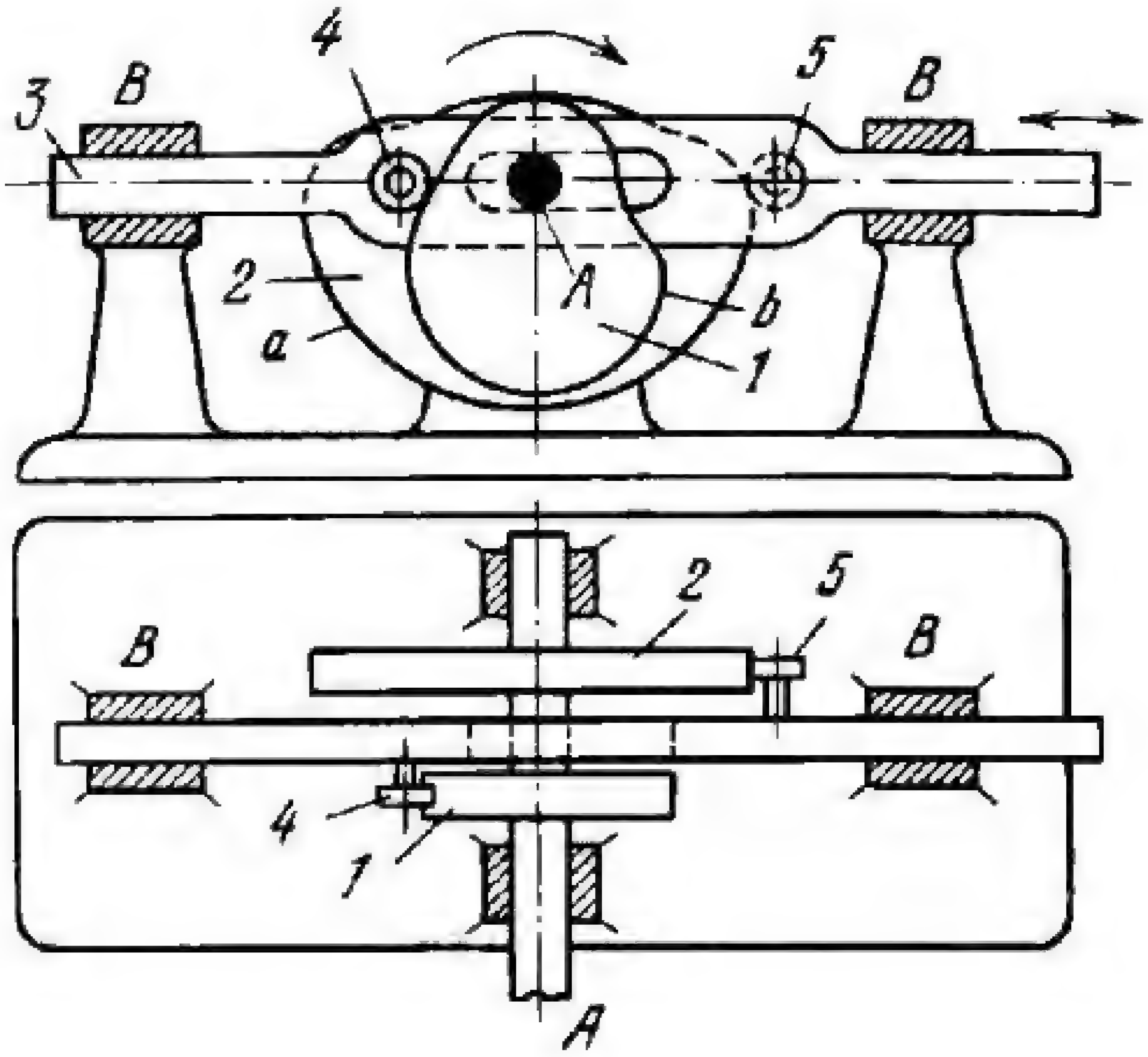
3130	FOUR-LINK CAM-APPLIED BRAKE MECHANISM	SmC Br



Cam *1* turns about fixed axis *A* and has working surface *b* which slides along flat surfaces *a* of shoes *2*. Shoes *2* turn about fixed axis *B*. When cam *1* is turned, shoes *2* are spread and forced against the inner surface of drum *4*. Spring *3* tends to retract the shoes and release the brake. It also holds shoes *2* in contact with cam *1*. Cam *1* has four separate working surfaces. If it is turned 90° so that the flat surfaces are between the shoes, the brake will remain in the applied position.

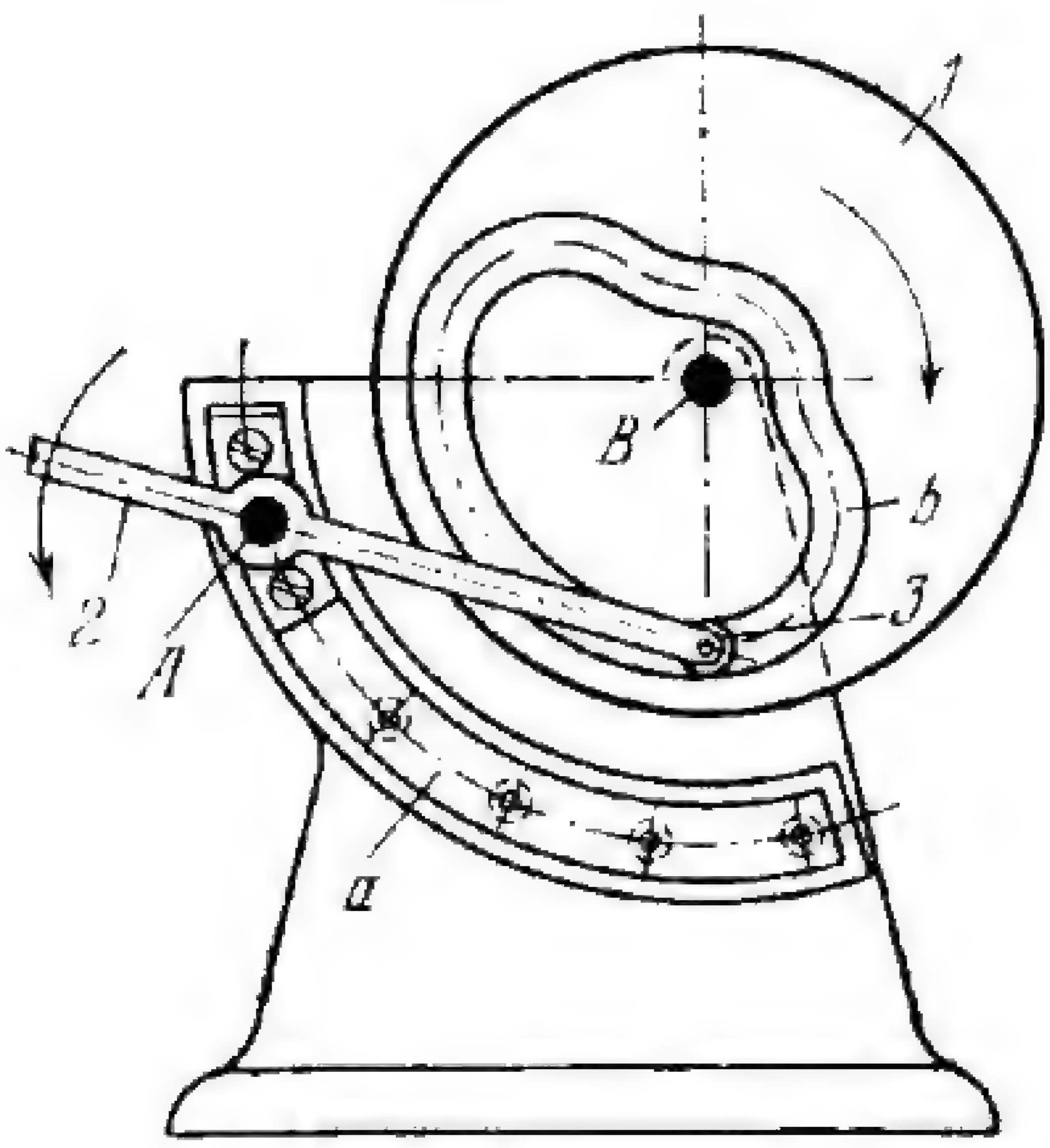
11. LINK-LENGTH ADJUSTMENT MECHANISMS
(3131 through 3144)

3131	THREE-LINK MAIN-AND-RETURN CAM MECHANISM	SmC LL



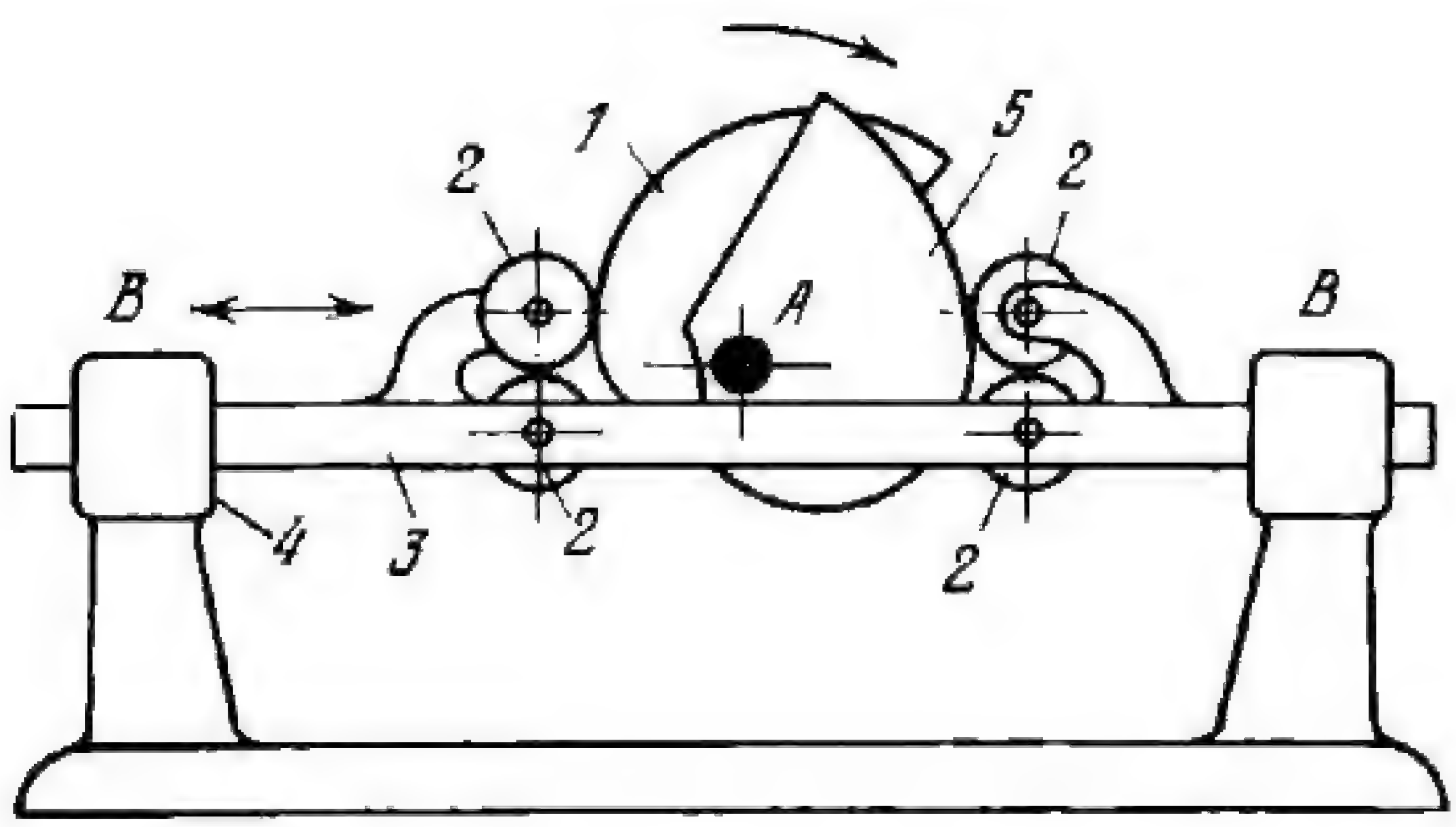
Main and return cams *1* and *2* are rigidly attached together and rotate about fixed axis *A*. Follower *3* reciprocates in fixed guides *B-B* and carries rollers *4* and *5* of which roller *4* rolls along working surface *b* of cam *1* and roller *5* rolls along surface *a* of cam *2*. Positive motion is achieved because the sums of all opposing radius vectors, one to a point of the theoretical, or pitch, curve of cam *1* and the other to the opposing point of the pitch curve of cam *2*, are constant and equal to the distance between the centres of rollers *4* and *5*.

3132	THREE-LINK FACE CAM MECHANISM WITH A VARIABLE AXIS OF FOLLOWER ROTATION	SmC LL



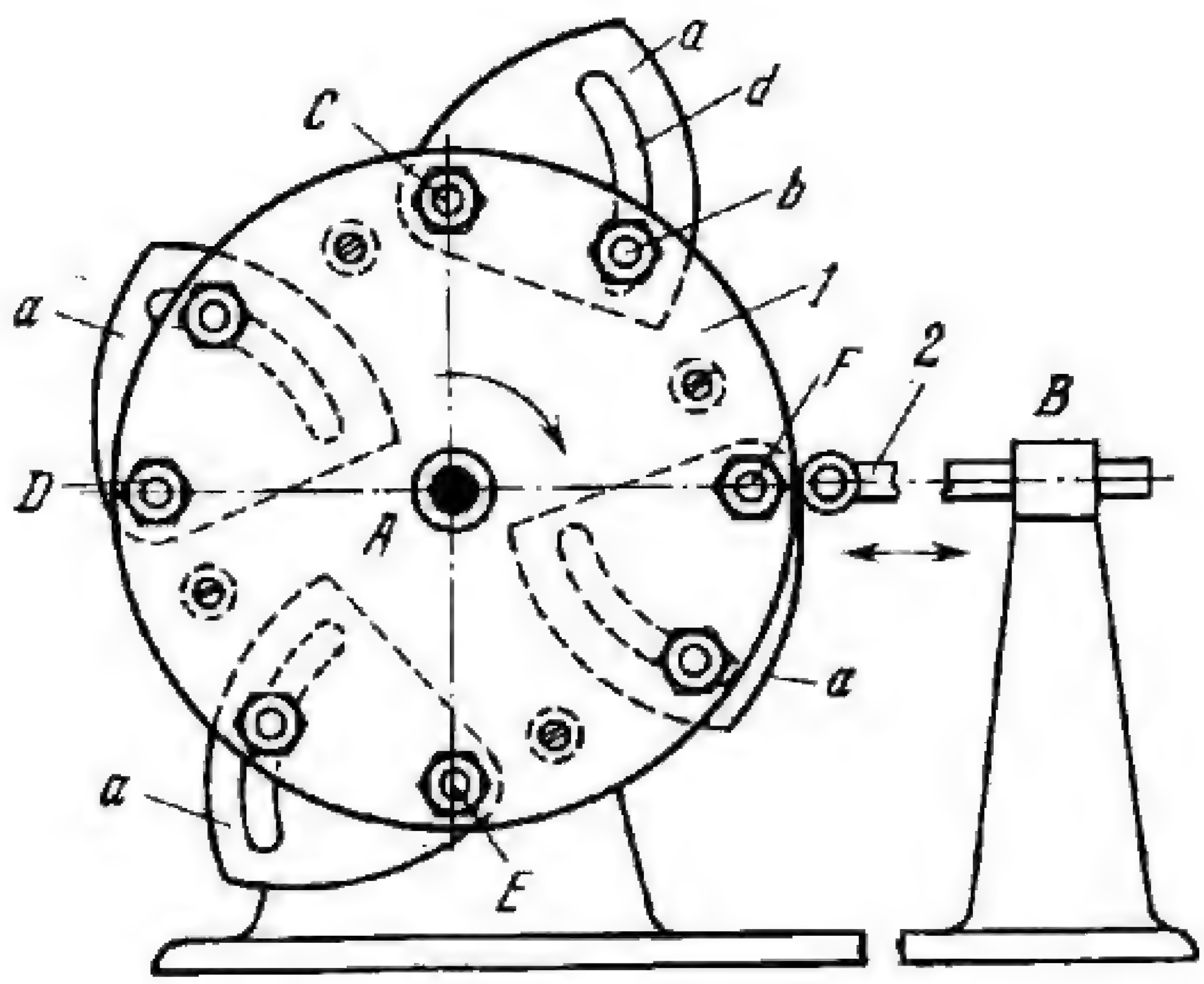
Cam *1* rotates about fixed axis *B* and has cam groove *b*. Follower *2* oscillates about fixed axis *A* and carries roller *3* which rolls and slides along groove *b*. Axis *A* can be adjusted along circular guide *a* (along an arc described from centre *B*) and clamped in the required position. This does not change the type of motion of follower *2*.

3133	ADJUSTABLE DOUBLE-CAM MECHANISM	SmC LL



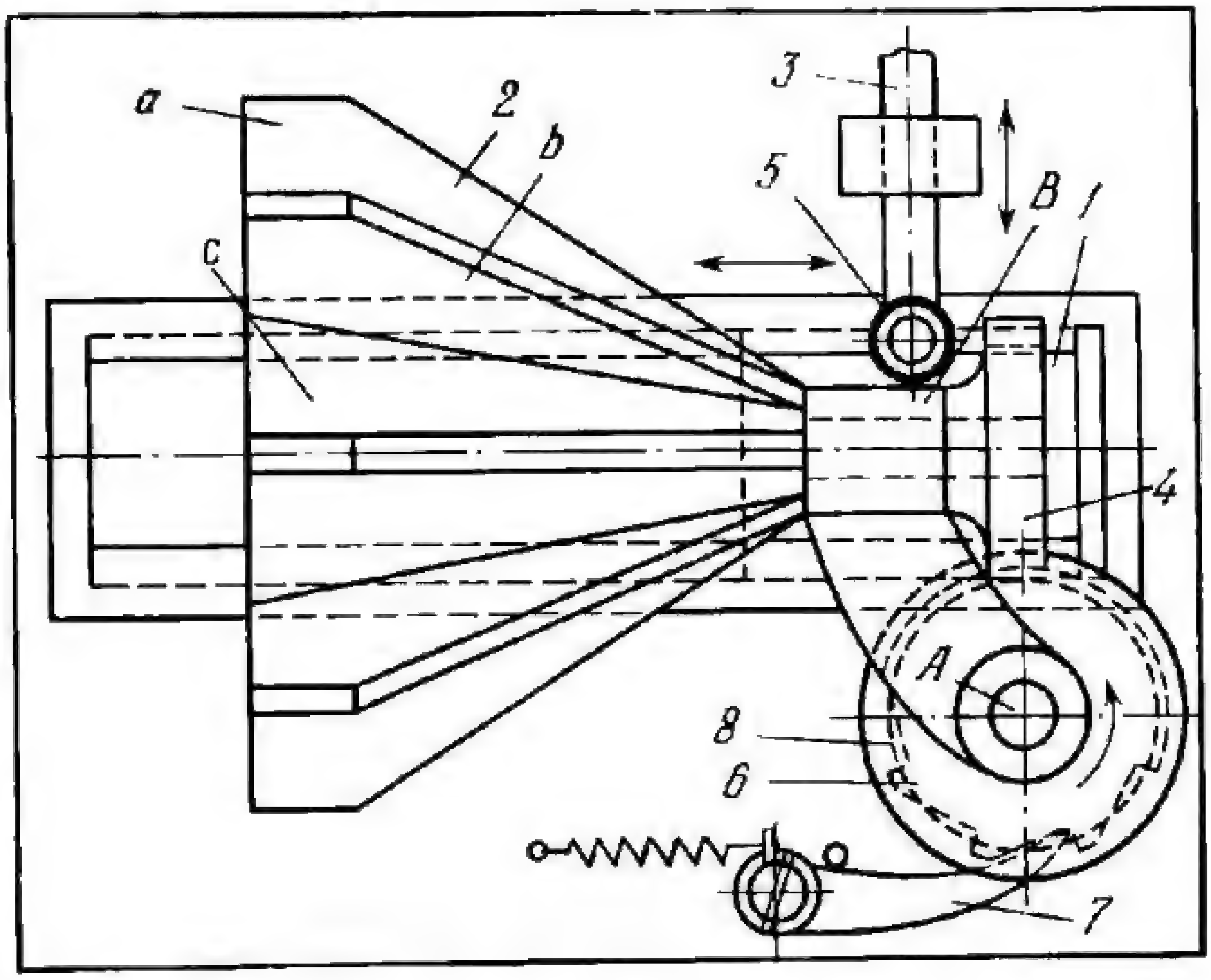
Two cams, *1* and *5*, with involute working surfaces, rotate about fixed axis *A*. The cams can be adjusted to different positions with respect to each other and clamped together. Follower *3* reciprocates in fixed guides *B-B* and carries four rollers *2* which roll along the contours of cams *1* and *5*. Cam *5* displaces follower *3* to the right, and cam *1* to the left.

3134	ADJUSTABLE-LOBE PLATE CAM MECHANISM	SmC LL



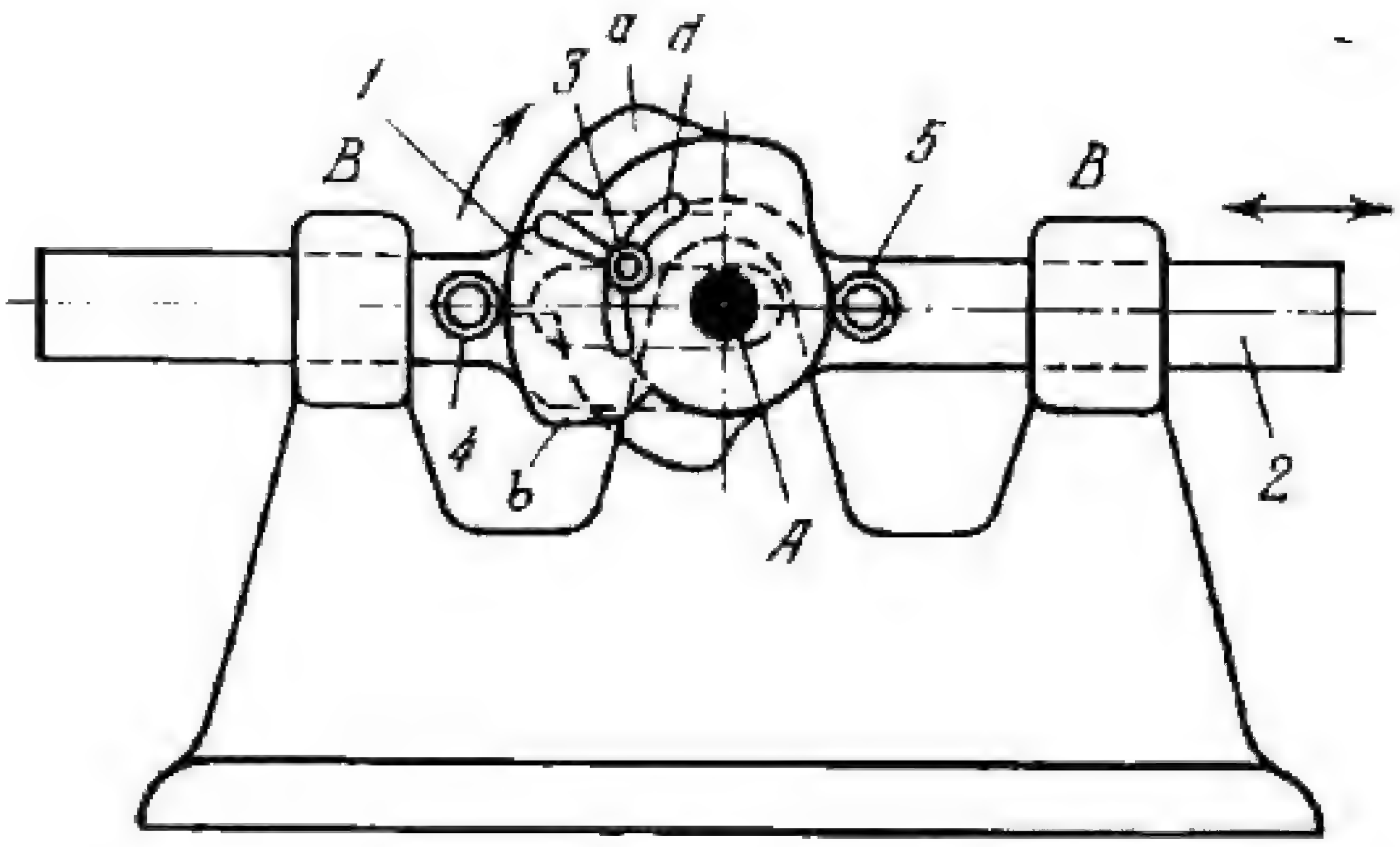
Cam-plate *1* rotates about fixed axis *A* and has four lobe members *a* with circular slots *d* whose axes are circular arcs described from centres *C*, *D*, *E* and *F*. Follower *2* reciprocates in fixed guide *B* and carries a roller which rolls along the working surfaces of lobe members *a*. Members *a* can be clamped in various positions with respect to cam-plate *1* by nuts *b*. Thus, in a single revolution of cam-plate *1*, follower *2* may have the same or four different types of motion with different strokes.

3135	INDEXING CAM MECHANISM FOR VARYING THE STROKE OF THE FOLLOWER	SmC LL



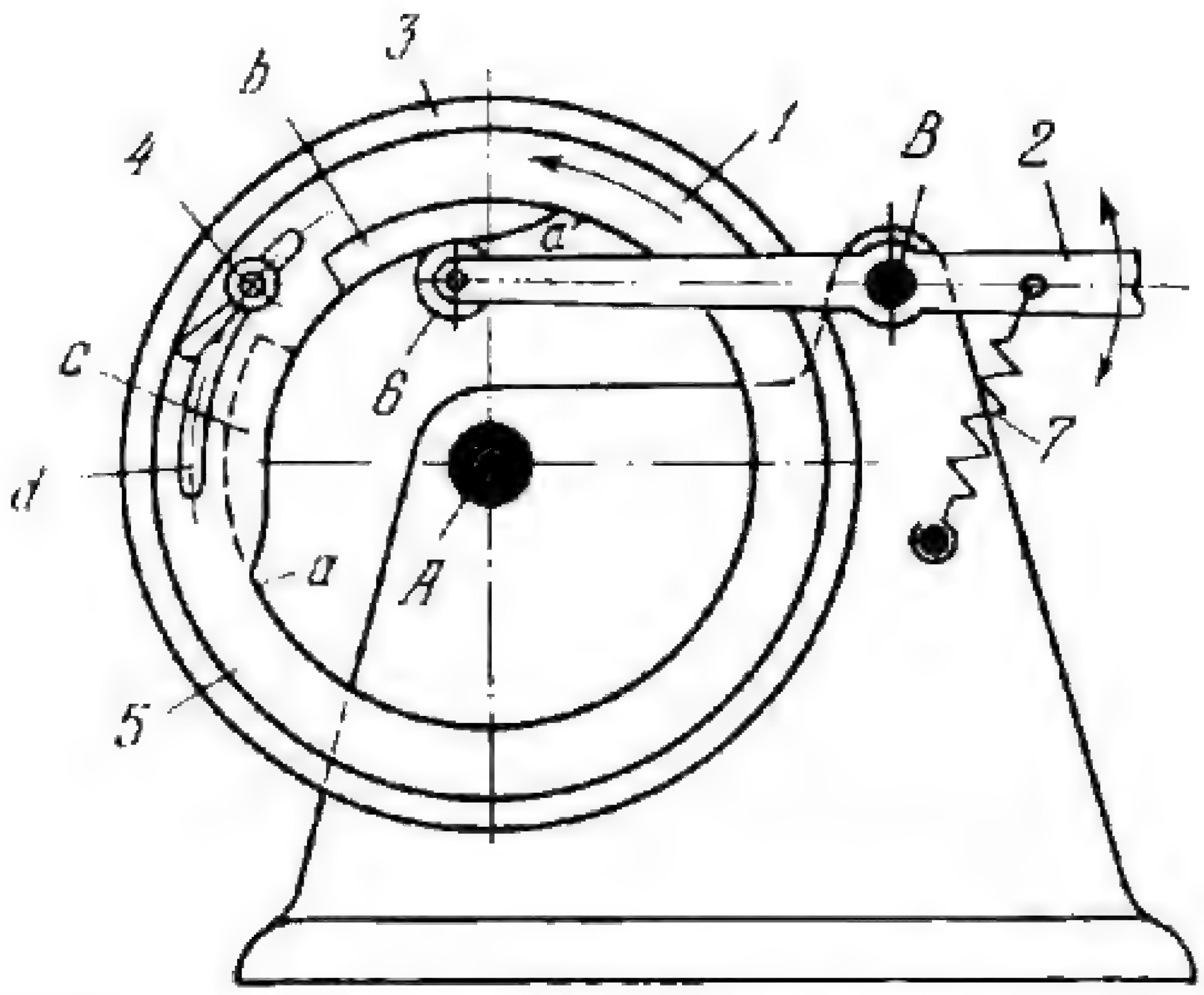
When slide *1* reciprocates along its fixed guides, follower *3* reciprocates in a fixed guide in a direction perpendicular to that of the slide. Cam member *2* consists of core *c* in which a number of cam inserts are secured. The inserts may be tapered at different angles and may be of different heights. When slide *1* travels to the right, roller *5* of follower *3* rolls along bearing *B* and then along the working surface of cam insert *a*, raising the follower. As the slide travels to the left, the follower is lowered by a spring (not shown). Near the end of the return stroke of slide *1*, a tooth of ratchet wheel *6*, which has as many teeth as there are inserts and rotates about axis *A* of slide *1*, engages pawl *7*. Pawl *7* indexes wheel *6* one tooth counterclockwise. This rotation is transmitted through helical gear *8*, rigidly attached to ratchet wheel *6*, and helical gear *4* which is keyed to the shaft of core *c* of cam member *2*. This indexes the cam to next insert *b* so that in the next stroke of slide *1*, roller *5* rolls along cam insert *b* which may impart a different stroke to follower *3*. Thus, each succeeding movement of the follower is varied until the cam member has been indexed one revolution and roll *5* is again in line with insert *a*. After this the cycle is repeated.

3136	**VARIABLE-DWELL CONSTANT-DIAMETER CAM MECHANISM**	**SmC** **LL**



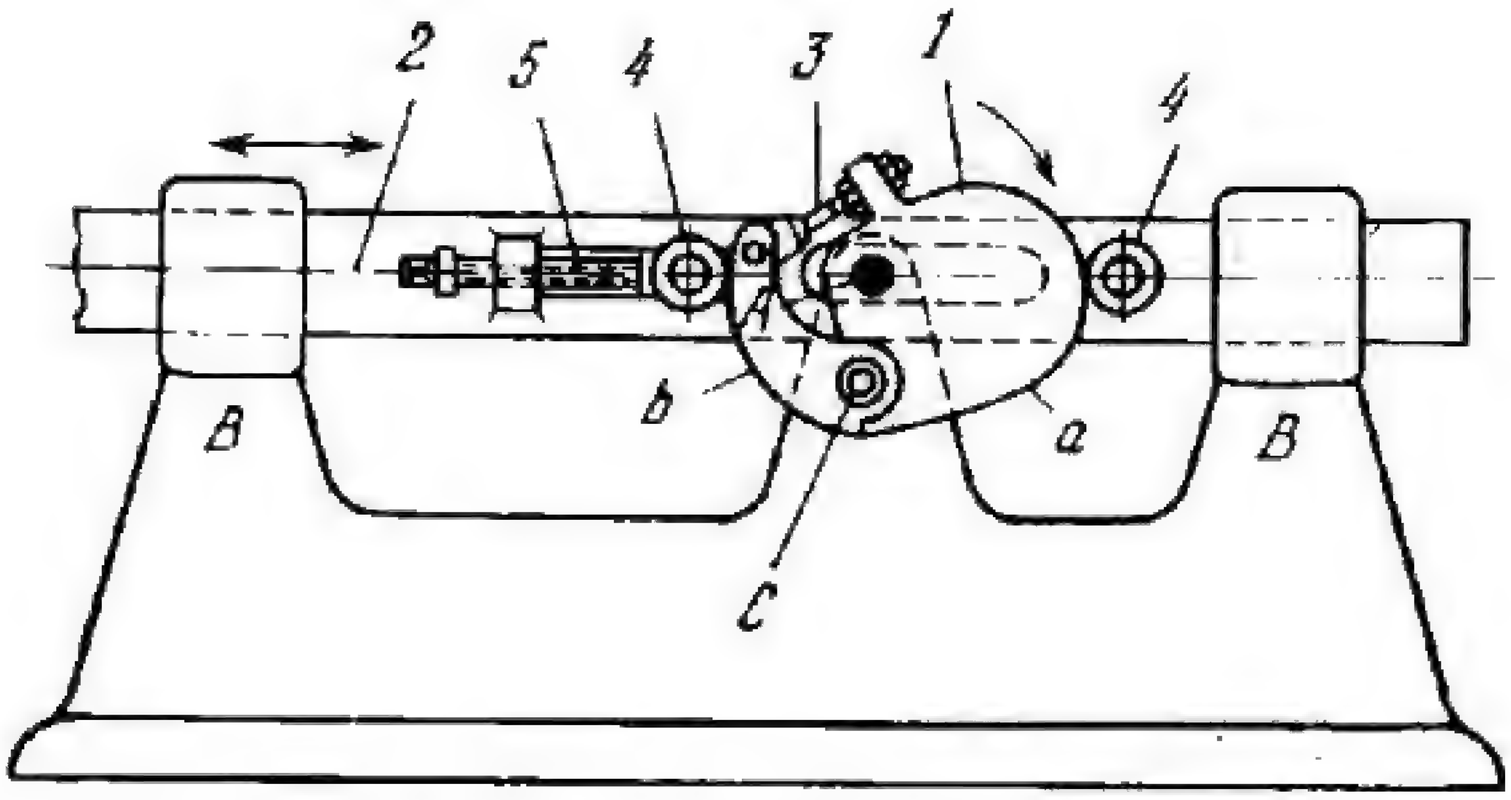
Cam *1* rotates about fixed axis *A* and consists of two members having lobes *a* and *b* along circular arcs. Follower *2* reciprocates in fixed guides *B-B* and carries rollers *4* and *5* which roll along the working surface of cam *1*. The members making up cam *1* can be shifted angularly with respect to each other along circular slot *d* and be clamped in the required position with wing nut *3*. This enables the parts of the working surface of the cam, described by an arc of a common radius from centre *A*, to be increased or decreased. Consequently, the dwell of follower *2* can also be increased or decreased within certain limits. Positive motion is achieved because the sums of opposing radius vectors to points on the theoretical, or pitch, curve of cam *1* are constant and equal to the distance between the centres of rollers *4* and *5*.

3137	VARIABLE-DWELL FACE CAM MECHANISM	SmC LL



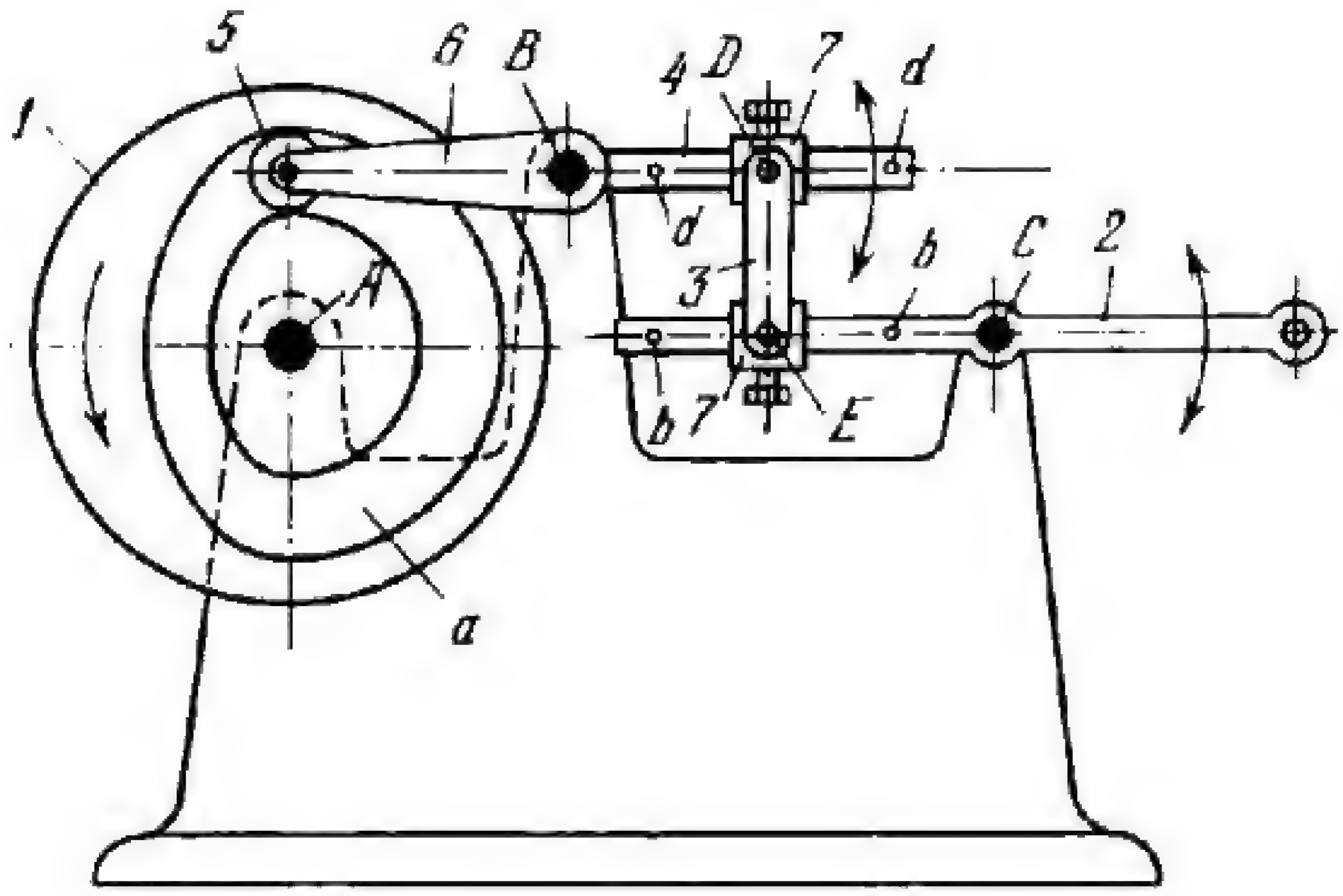
Cam *1* rotates about fixed axis *A* and consists of two rings, *3* and *5*, with internal lobe members *b* and *c*. The rings can be turned with respect to each other and clamped in the required position by a bolt passing through slots *d* on the rings and wing nut *4*, thereby increasing or decreasing the length of concentric circular arc *a-a*. Follower *2* oscillates about fixed axis *B* and carries roller *6* which rolls along the working surface of cam *1*. Follower *2* has a dwell that can be varied when roller *6* is on the circular surface *a-a* of the cam. Roller *6* is held in contact with cam *1* by spring *7*.

3138	VARIABLE-STROKE PLATE CAM MECHANISM	SmC LL



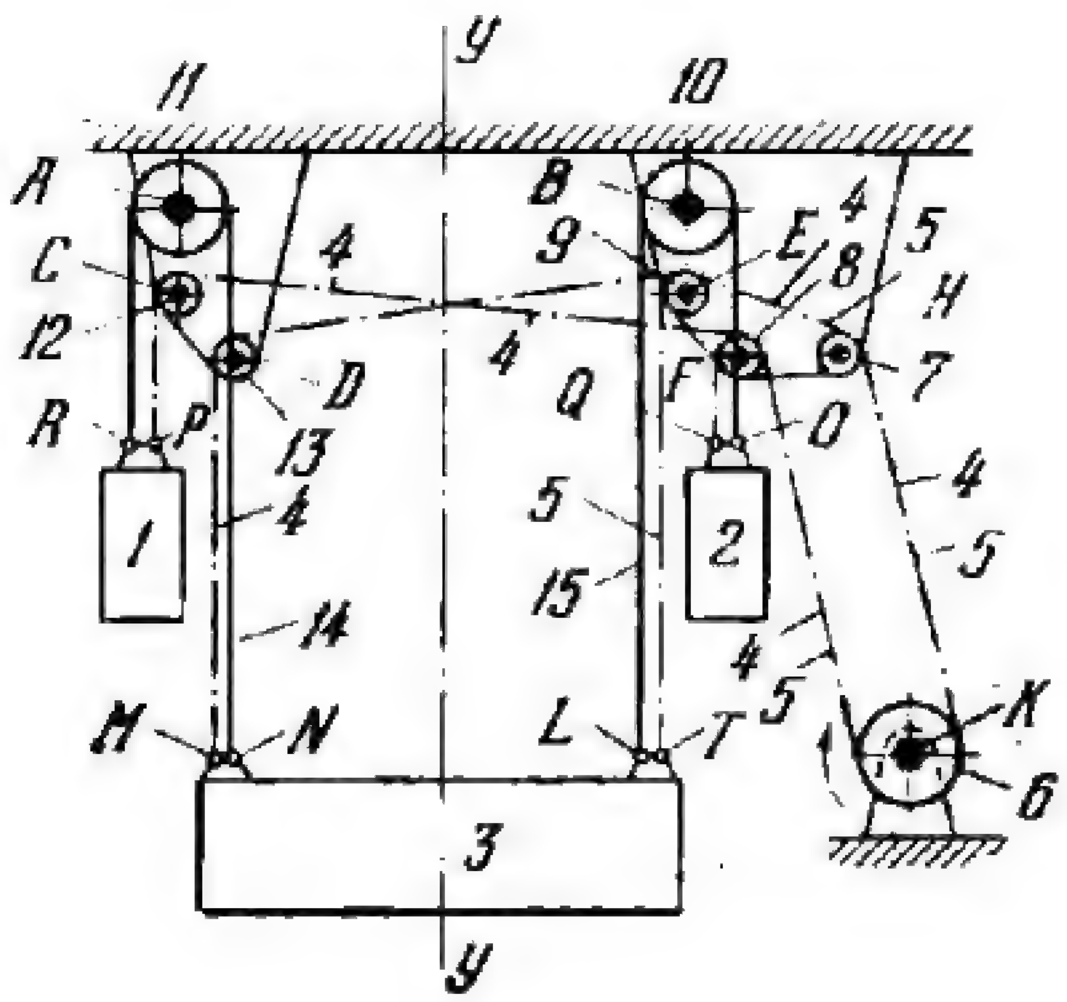
Cam *1* rotates about fixed axis *A* and consists of constant member *a* and adjustable member *b* which can be turned about axis *C* of the constant member by means of screw device *3* to change the working surface of cam *1* as a whole. Follower *2* reciprocates in fixed guides *B-B* and carries rollers *4* which roll along the working surface of cam *1*. When the working surface of cam *1* is changed, it is necessary to change the distance between the centres of rollers *4* by means of screw device *5* which displaces left-hand roller *4* along the axis of follower *2*. This adjustment retains positive motion.

3139	FACE CAM MECHANISM WITH VARIABLE FOLLOWER OSCILLATION	SmC LL



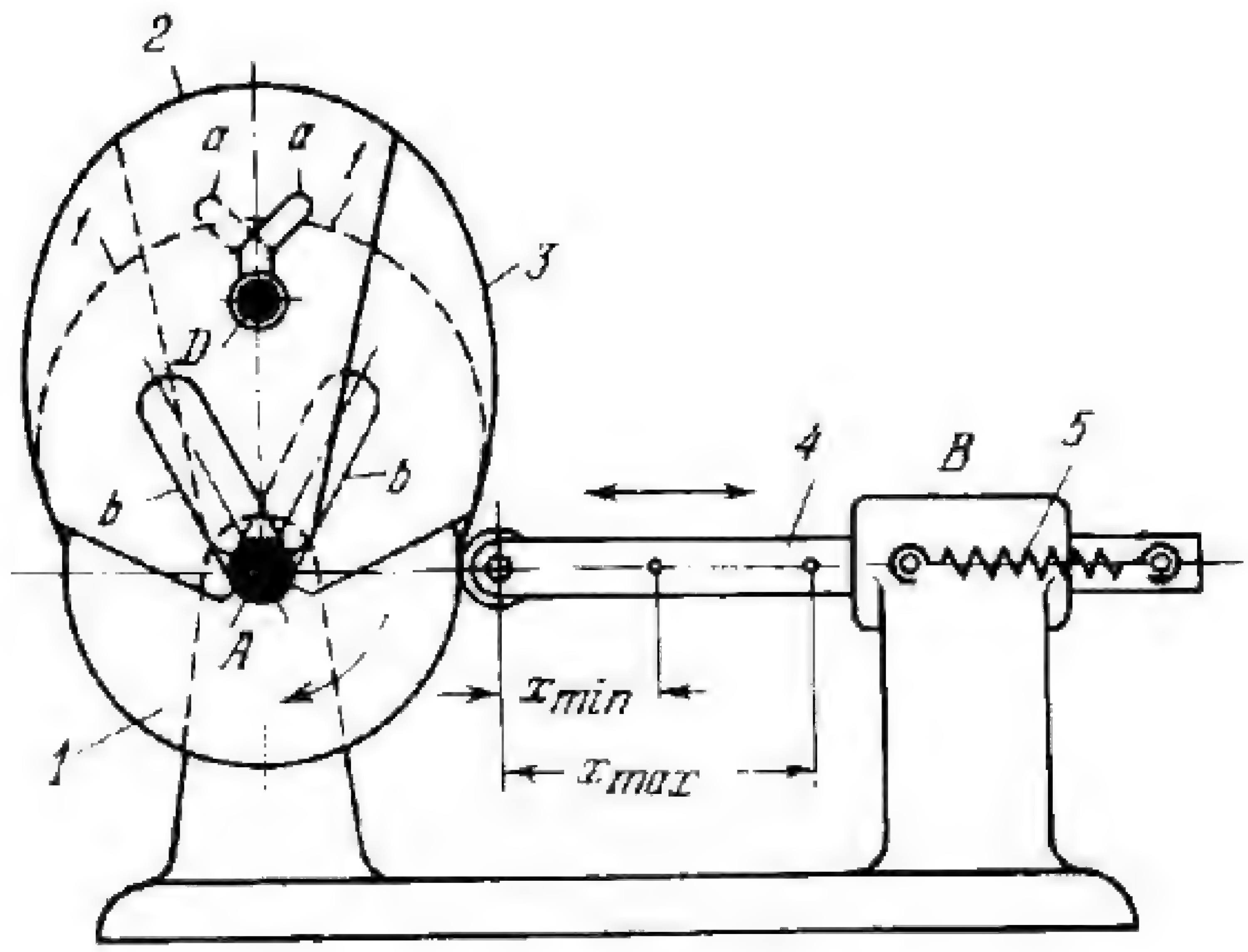
Cam *1* rotates about fixed axis *A* and has profiled groove *a*. Follower *6* oscillates about fixed axis *B* and carries roller *5* which rolls and slides along groove *a*. Rigidly attached to follower *6* is bar *4* which has a number of holes *d*. Secondary follower *2* oscillates about fixed axis *C* and has a number of holes *b*, opposite holes *d* of bar *4*. Intermediate link *3* is connected by turning pairs *D* and *E* to collars *7* which can be adjusted along bar *4* and follower *2* and clamped in the required positions by screws whose tips enter holes *d* and *b*. The angle of oscillation of secondary follower *2* can be varied by setting collars *7* in various positions.

3140	FLEXIBLE-LINK MECHANISM FOR HOISTING A PLATFORM	SmC LL



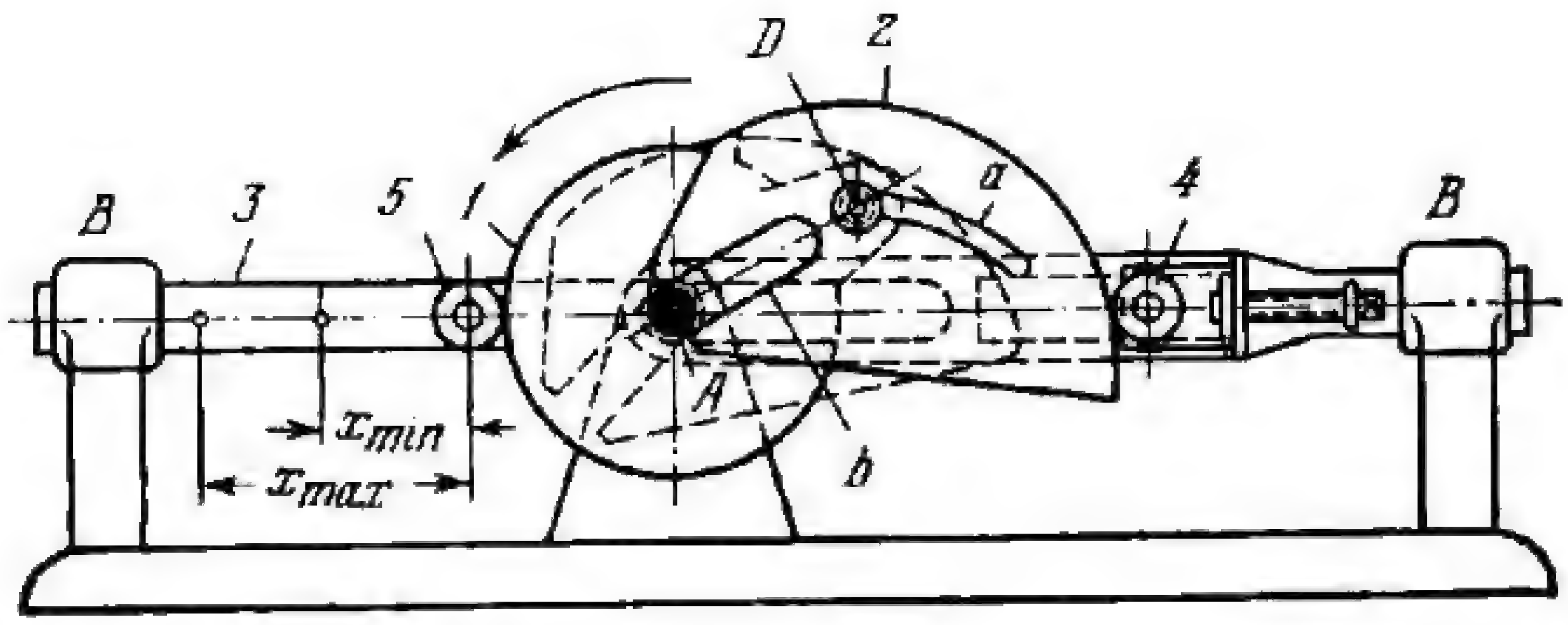
Sheaves *10* and *11*, of equal diameter, rotate about fixed axes *B* and *A*. Sheaves *9*, *7*, *8*, *12* and *13* rotate about fixed axes *E*, *H*, *F*, *C* and *D*. Driving sheave *6* rotates about fixed axis *K*. Flexible link *4*, connected to platform *3* at point *M*, runs over sheaves *13*, *9*, *7*, *6*, *8* and *12*. The second end of flexible link *4* is connected to counterbalancing weight *1* at point *P*. Flexible link *5*, connected to platform *3* at point *T*, runs over sheaves *9*, *7*, *6* and *8*, and has its second end connected to counterbalancing weight *2* at point *Q*. Thus both flexible links, *4* and *5*, run over common driving sheave *6*. Flexible links *14* and *15*, connected to platform *3* at points *N* and *L*, run over sheaves *11* and *10*, and their other ends are connected to counterbalancing weights *1* and *2* at points *R* and *O*. Platform *3* is raised or lowered by rotating sheave *6* about axis *K*. The platform has straight translational motion along axis *y*-*y*.

3141	VARIABLE-STROKE PLATE CAM MECHANISM	SmC LL



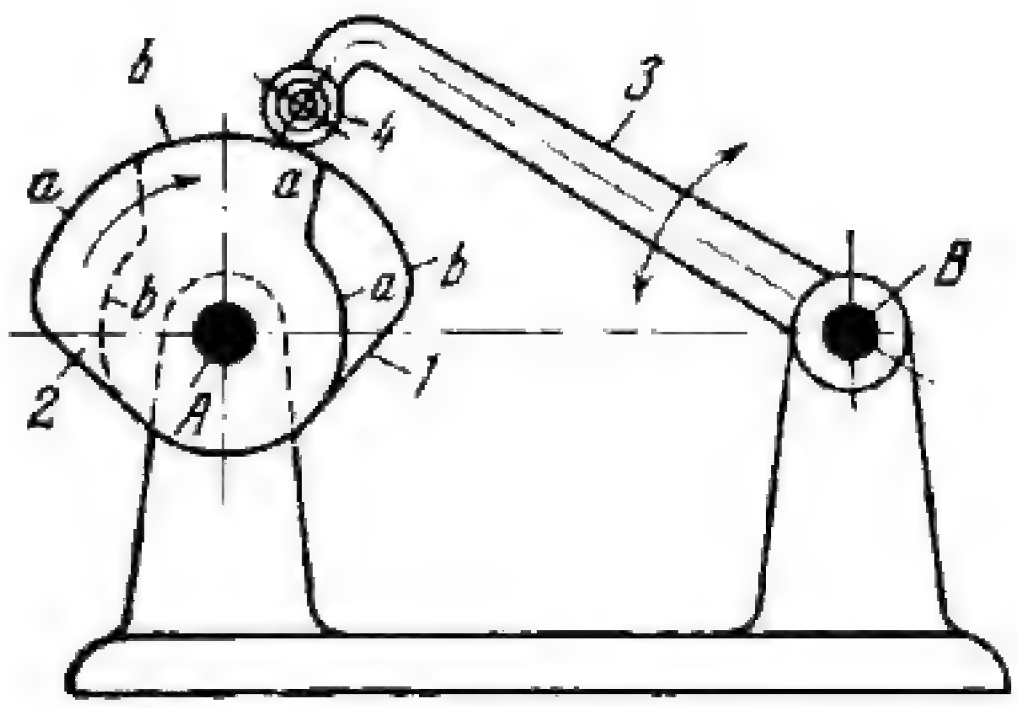
The cam consists of main lobe member *1*, rotating about fixed axis *A*, and two lobe members, *2* and *3*, which can be adjusted to various positions with respect to member *1*. For the purpose of adjustment, members *2* and *3* have curvilinear slots *a*, which can slide along bolt *D*, and straight slots *b*, which can slide along the shaft of member *1*. Lobe members *2* and *3* can be rigidly clamped on member *1* by means of a nut on bolt *D*. Follower *4* reciprocates in fixed guide *B* and carries a roller that rolls along the working surface of the cam. By clamping members *2* and *3* in various positions, the stroke of follower *4* can be varied within the limits from x_{min} to x_{max}. The roller of follower *4* is held in contact with the cam by spring *5*.

3142	VARIABLE-STROKE PLATE CAM MECHANISM	SmC LL



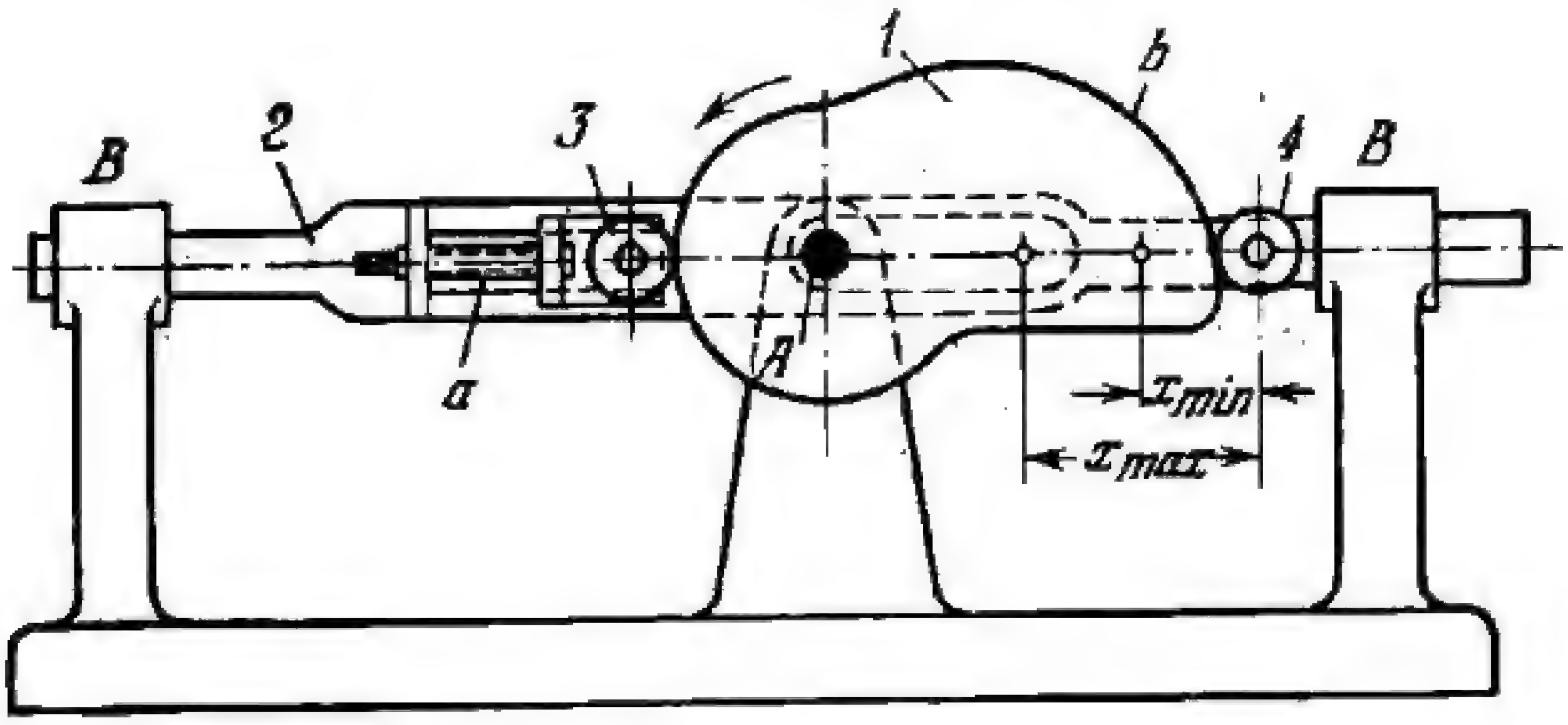
The cam consists of main lobe member *1*, rotating about fixed axis *A*, and lobe member *2* which can be adjusted to various positions with respect to member *1*. For the purpose of adjustment, member *2* has curvilinear slot *a*, which can slide along bolt *D*, and straight slot *b*, which can slide along the shaft of member *1*. Lobe member *2* can be rigidly clamped on member *1* by means of a nut on bolt *D*. Follower *3* reciprocates in fixed guides *B-B* and carries rollers *4* and *5* which roll along the working surface of the cam. By clamping member *2* in various positions, the stroke of follower *3* can be varied within the limits from x_{min} to x_{max}. Roller *4* can be adjusted to various positions along follower *3* by a screw device. The working surface of cam member *1* acts alternately on rollers *5* and *4*. The rollers are held in contact with the cam by special springs (not shown). Impacts occur when the rollers come into contact with the lobe members.

3143	ADJUSTABLE-LOBE PLATE CAM MECHANISM	SmC LL



Rigidly attached lobe members *1* and *2* rotate about fixed axis *A*. Working surfaces *a-a* and *b-b* of members *2* and *1* are profiled along the same curve. Follower *3* oscillates about fixed axis *B* and carries roller *4* which rolls along the working surface of the lobe members. By angularly displacing members *1* and *2* with respect to each other and clamping them rigidly together again in the required position, the total working surface of the cam can be varied, thereby varying the phases of motion of follower *3*.

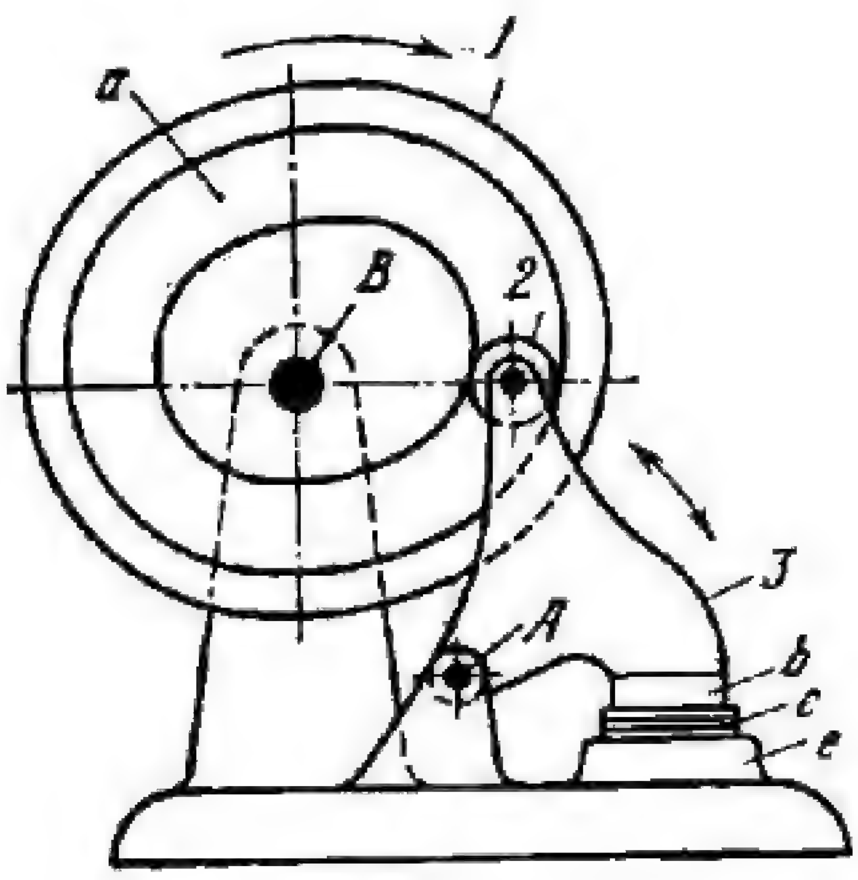
3144	VARIABLE-STROKE PLATE CAM MECHANISM	SmC LL



Cam *1* rotates about fixed axis *A*. Follower *2* reciprocates in fixed guides *B-B* and carries rollers *3* and *4*. Roller *3* can be adjusted to various positions along follower *2* by screw device *a*. In the position shown, the follower stroke has its maximum value x_{max}. By changing the position of roller *3*, the stroke of the follower can be varied within the limits from x_{min} to x_{max}. Working surface *b* of cam *1* acts alternately on rollers *3* and *4*. The rollers are held in contact with the cam by special springs (not shown). Impacts occur when lobe *b* of the cam comes into contact with the rollers.

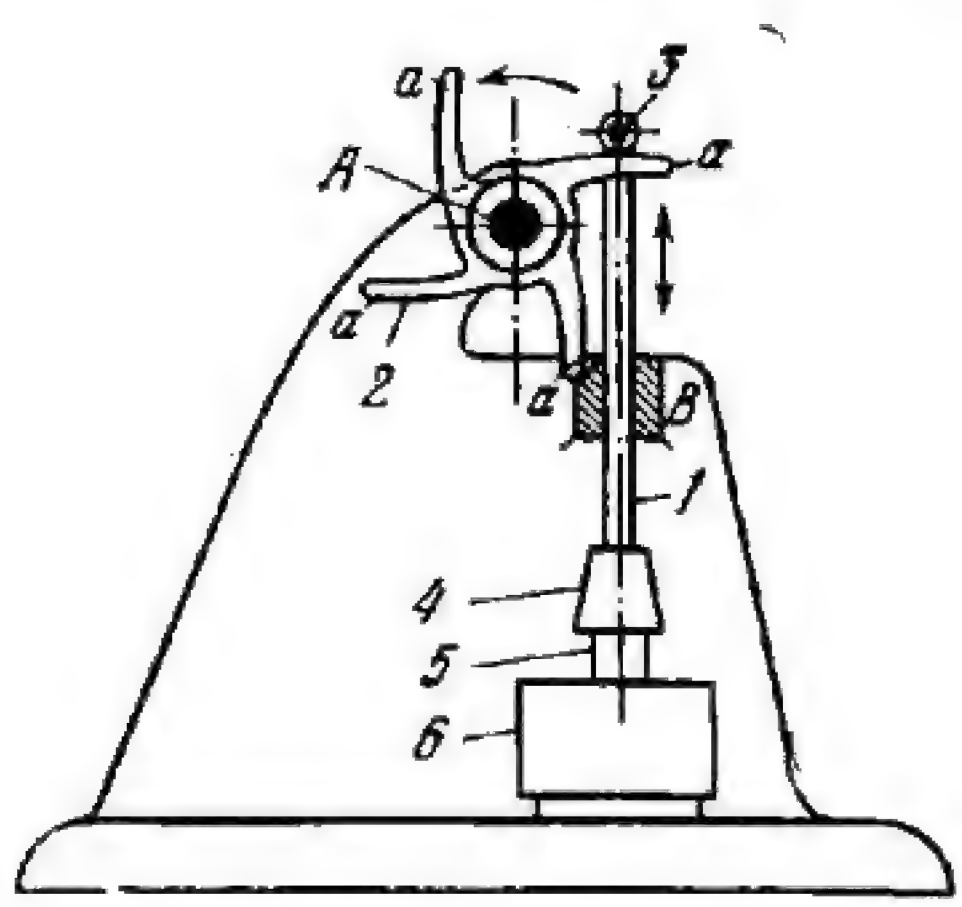
12. HAMMER, PRESS AND DIE MECHANISMS (3145, 3146 and 3147)

3145	THREE-LINK FACE CAM MECHANISM OF A LEVER PRESS	SmC HP



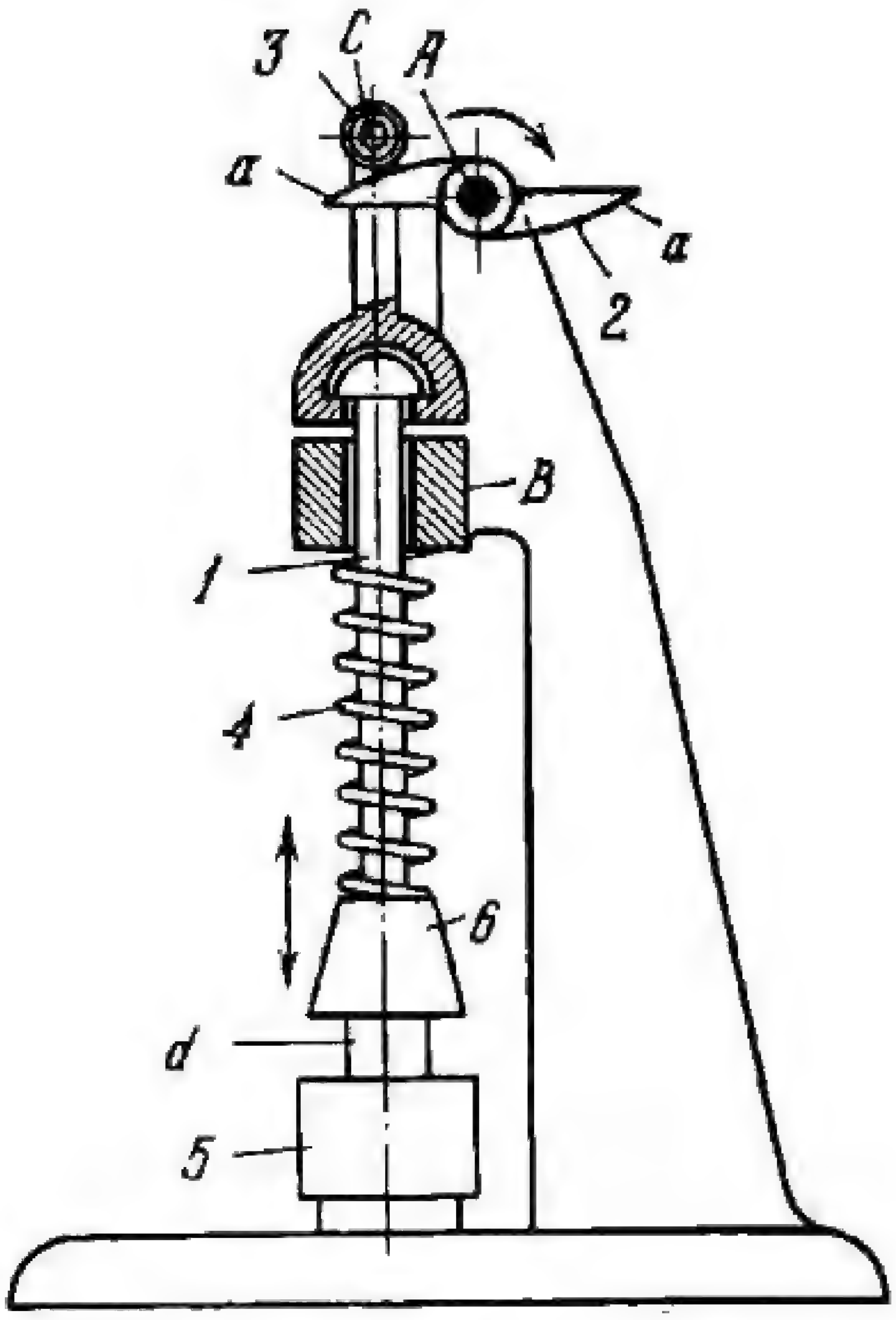
Cam *1* rotates about fixed axis *B* and has profiled groove *a*. Lever (follower) *3* oscillates about fixed axis *A* and carries roller *2* which rolls and slides along groove *a*. Mounted on lever *3* is upper plate *b*. Stock *c*, to be pressworked, is placed between plate *b* and fixed plate *e*.

3146	THREE-LINK FOUR-FINGER CAM MECHANISM OF A DROP HAMMER	SmC HP



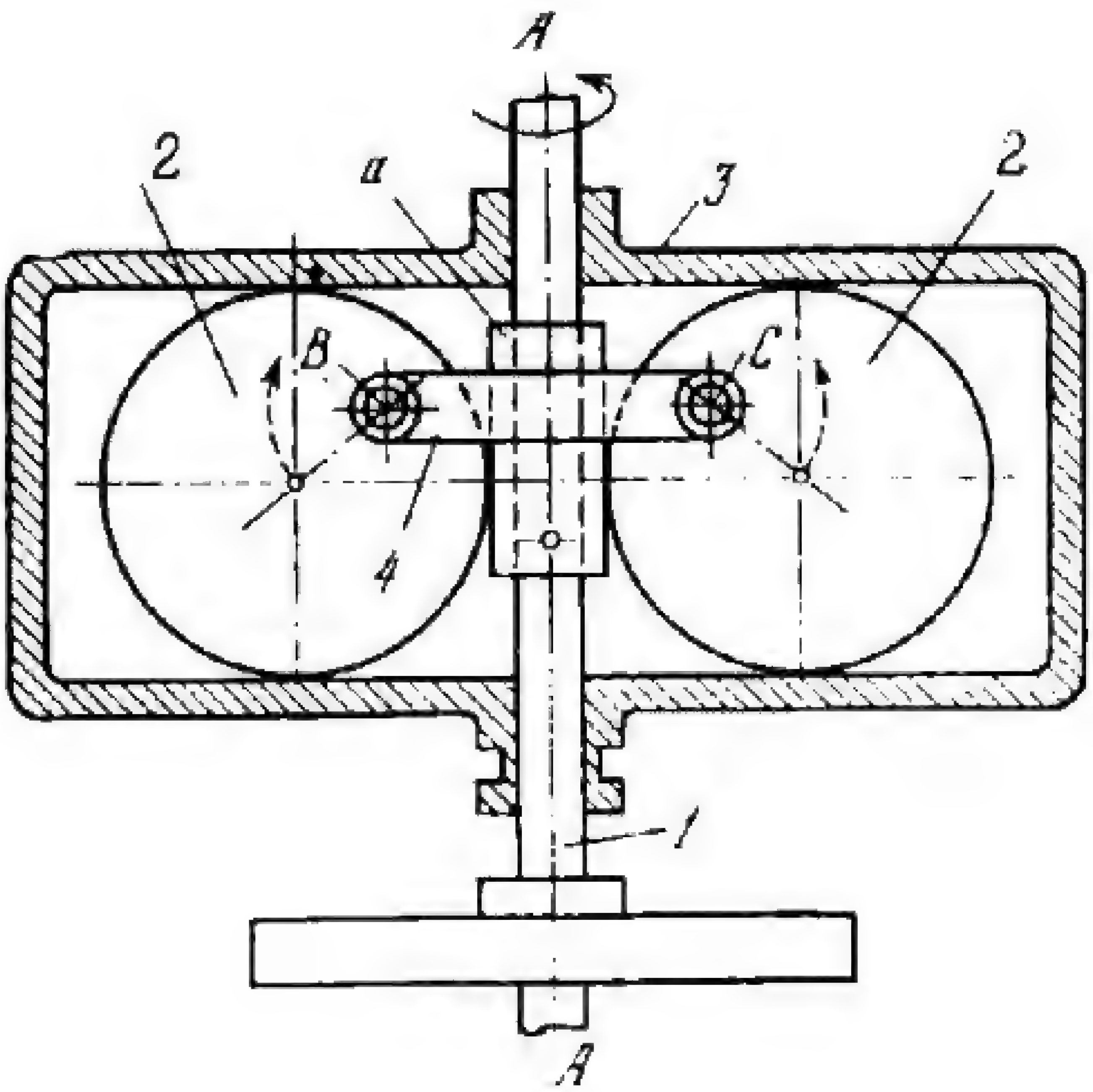
Cam *2* rotates about fixed axis *A* and has four fingers *a*. Ram (follower) *1* reciprocates with ram die *4* in fixed guide *B* and carries roller *3* which periodically engages fingers *a* of cam *2*. As each finger turns out of contact with roller *3*, ram *1* and die *4* drop by gravity and strike billet *5* which lies on fixed anvil die *6*. In one cycle, ram *1* has four periods in which it is raised and four periods in which it drops.

3147	THREE-LINK CAM MECHANISM OF A SPRING HAMMER	SmC HP



Cam 2 rotates about fixed axis A and has two profiled lobes a. Ram (follower) 1 reciprocates with ram die 6 in fixed guide B and carries roller 3 which rotates about axis C. Ram 1 is raised when roller 3 engages one of lobes a of cam 2, compressing spring 4. As each lobe a turns out of contact with roller 3, ram 1 and die 6 drop by gravity and the action of spring 4 and strike billet d which lies on fixed anvil die 5. In one cycle, ram 1 has two periods in which it is raised and two periods in which it drops.

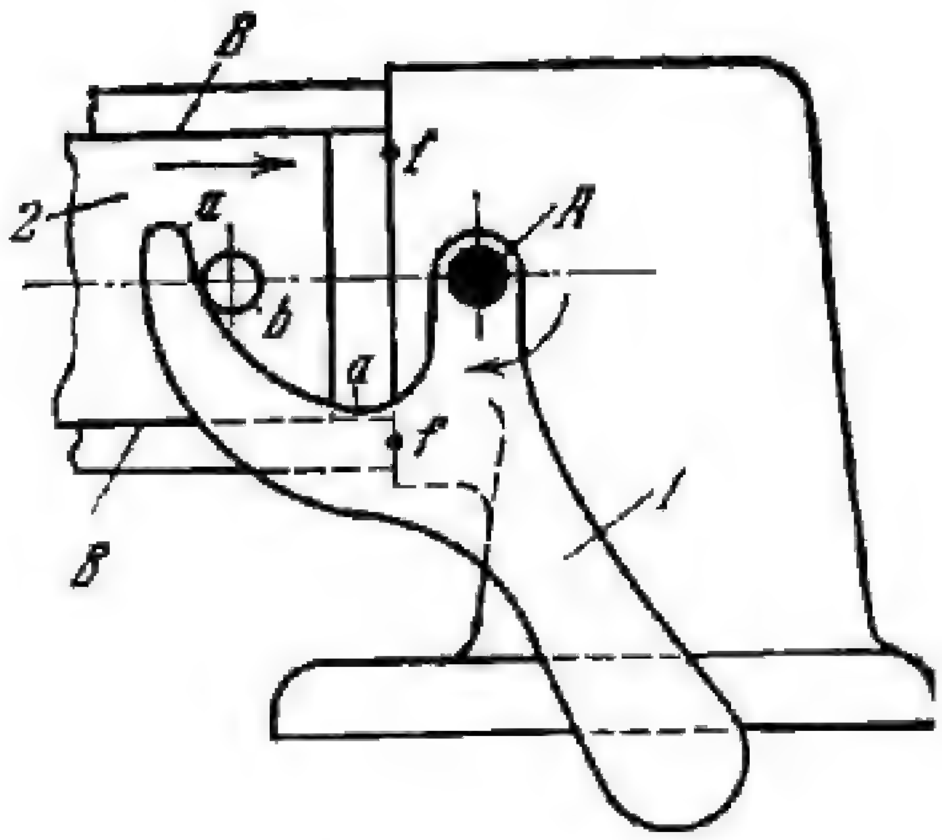
3148	CAM-TYPE CENTRIFUGAL GOVERNOR MECHANISM WITH ECCENTRIC WEIGHTS	SmC G



Shaft *1* rotates about fixed axis *A-A* and carries rigidly attached guide *a*. Crosspiece *4* slides along guide *a* and is connected by turning pairs *B* and *C* to round eccentrics *2* which are enclosed in housing *3*. When shaft *1* rotates, eccentric weights *2* are turned by centrifugal force about axes *B* and *C*, thereby shifting housing *3* along shaft *1*. The link controlling the speed of shaft *1* is connected to housing *3*.

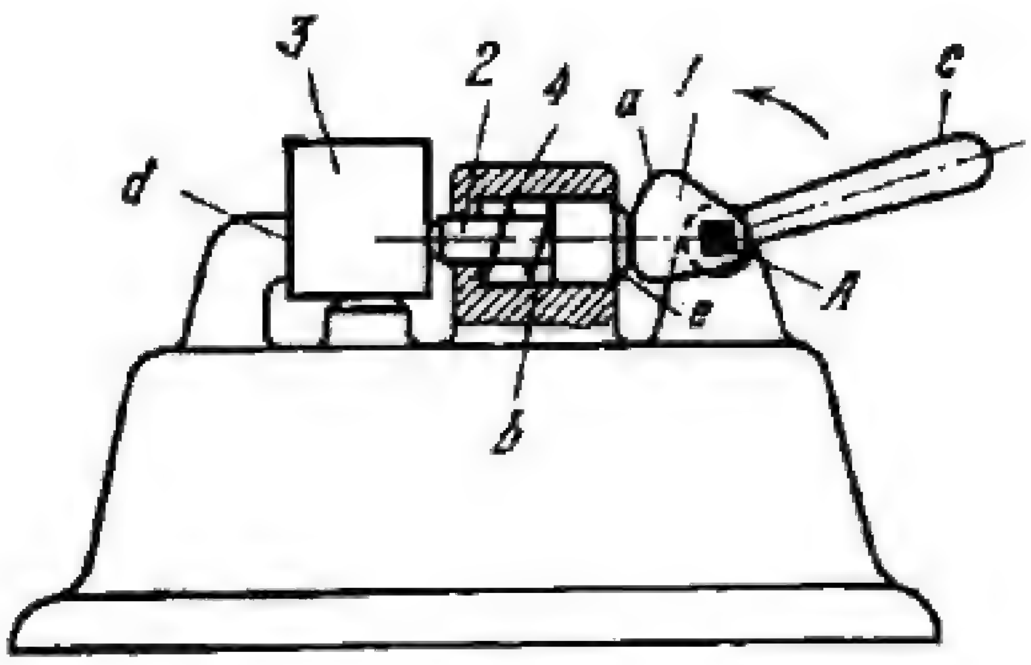
14. GRIPPING, CLAMPING AND EXPANDING MECHANISMS (3149 through 3152)

3149	THREE-LINK CAM LATCH MECHANISM	SmC GC



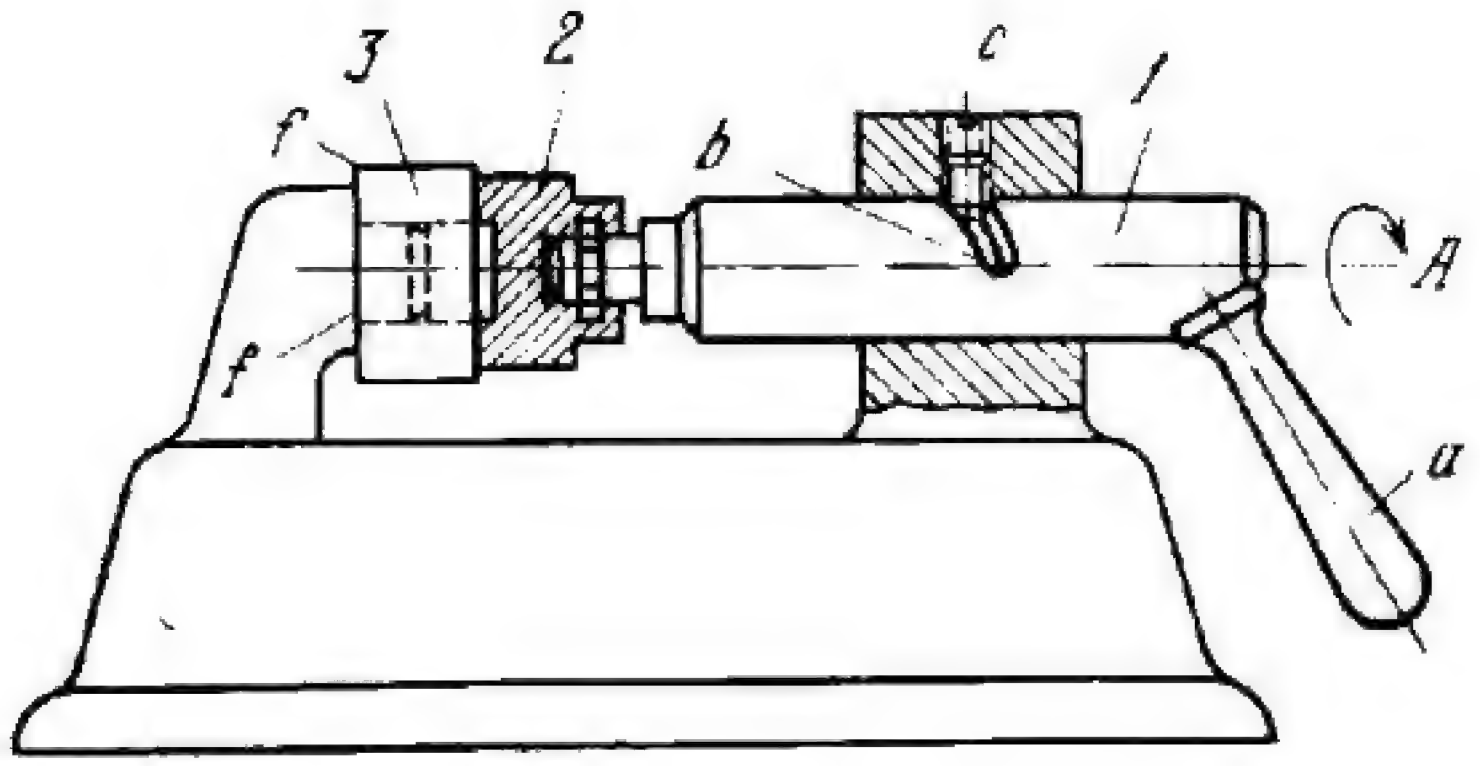
Latch lever *1* turns about fixed axis *A* and has profiled cam surface *a-a*. Slide *2* moves in fixed guides *B-B* and has pin *b* which is engaged by surface *a-a* of lever *1*. To clamp and lock slide 2 against fixed flat surface *f-f*, lever *1* is turned clockwise. The profile of surface *a-a* is designed to prevent unintentional movement of slide *2* away from surface *f-f*.

3150	THREE-LINK CAM-ACTUATED CLAMP MECHANISM	SmC GC



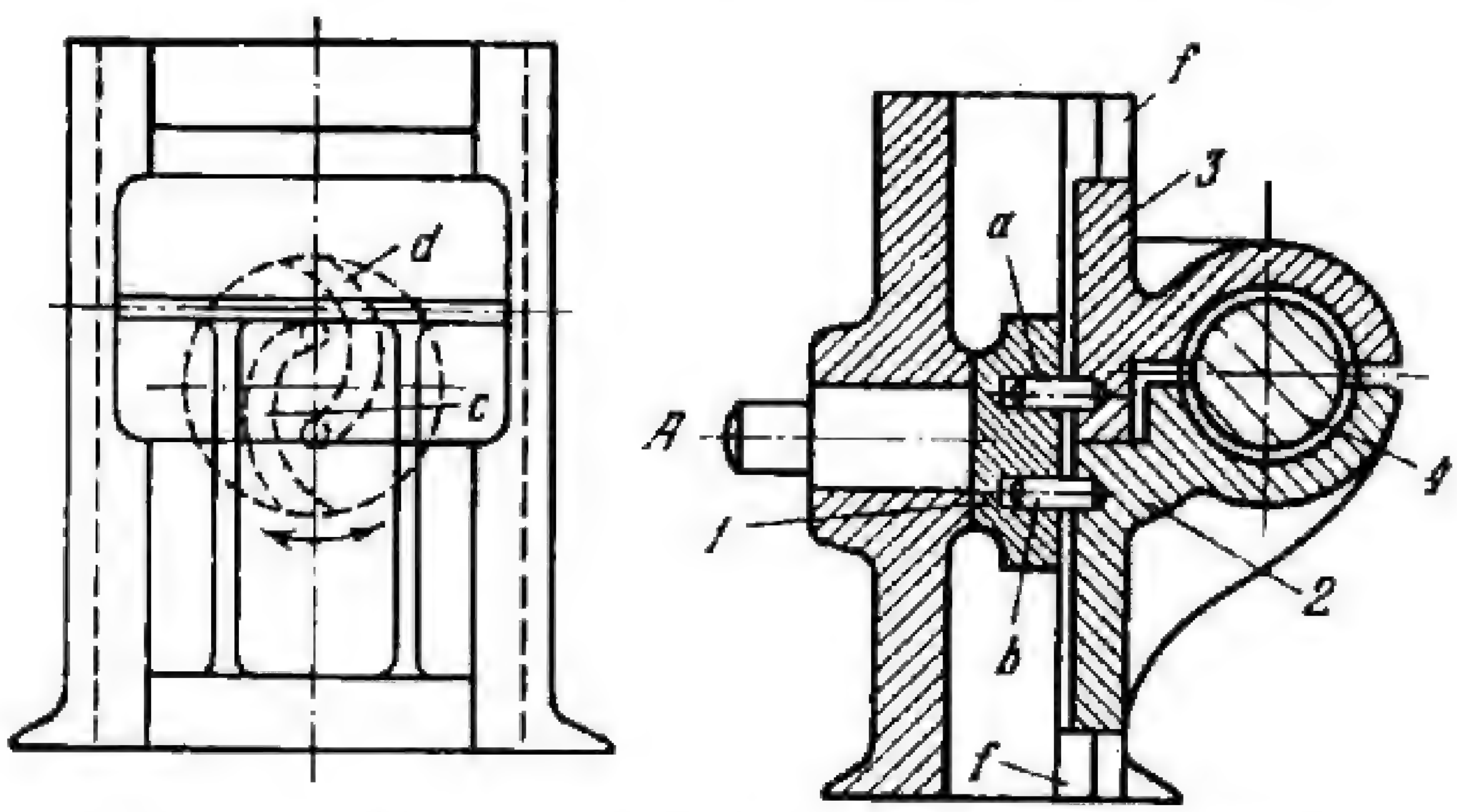
Cam *1* turns about fixed axis *A* and its working surface *a* slides along flat surface *e* of clamping plunger *2* which slides in fixed guide *b*. When handle *c* is turned counterclockwise, workpiece *3* is clamped against fixed surface *d*. When handle *c* is turned clockwise, spring *4* forces lunger *2* to the right, releasing workpiece *3*.

3151	HELICAL-GROOVE CAM-TYPE SPATIAL CLAMPING MECHANISM	SmC GC



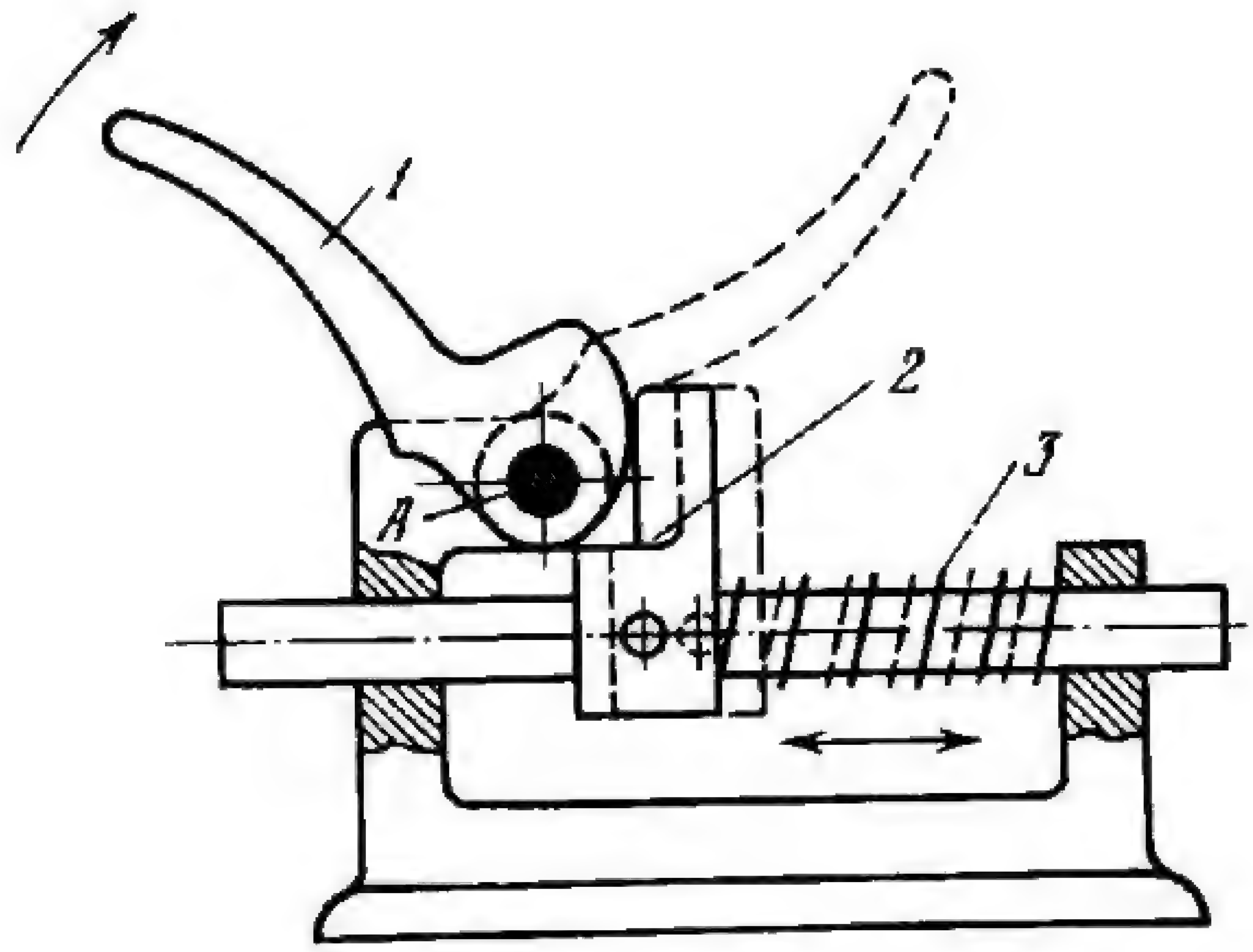
Cam-type clamping plunger *1* turns about axis *A* and has helical groove *b* which slides along the dog point of setscrew *c*. Connected to plunger *1* is swivel pad *2* which clamps workpiece *3* against fixed flat surface *f-f* when handle *a* of plunger *1* is turned clockwise.

3152	FOUR-LINK FACE CAM MECHANISM FOR OPERATING LEAD-SCREW HALF-NUTS	SmC GC



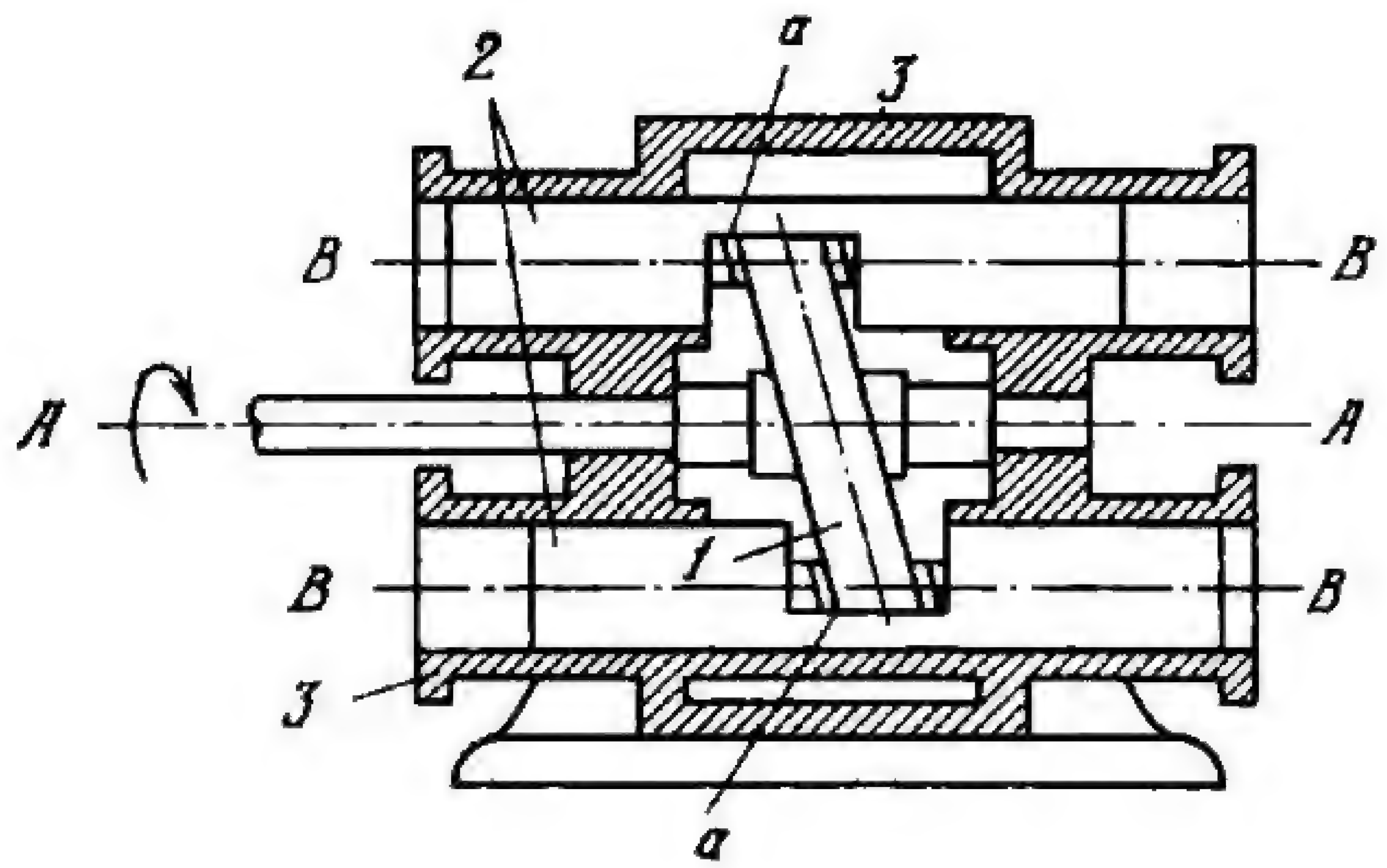
Cam *1* turns about fixed axis *A* and has two spiral grooves, *c* and *d*. Half-nut slides *2* and *3* travel along fixed guides *f-f*. Pins *a* and *b* of slides *3* and *2* engage grooves *c* and *d* of cam *1*. When cam *1* is turned counterclockwise, slides *2* and *3* move towards each other, closing the half-nuts over the thread of lead screw *4*. When cam *1* is turned clockwise, slides *2* and *3* move apart, opening the half-nuts to disengage them from lead screw *4*.

3153	THREE-LINK CAM-TYPE BAR INDEXING MECHANISM	SmC I



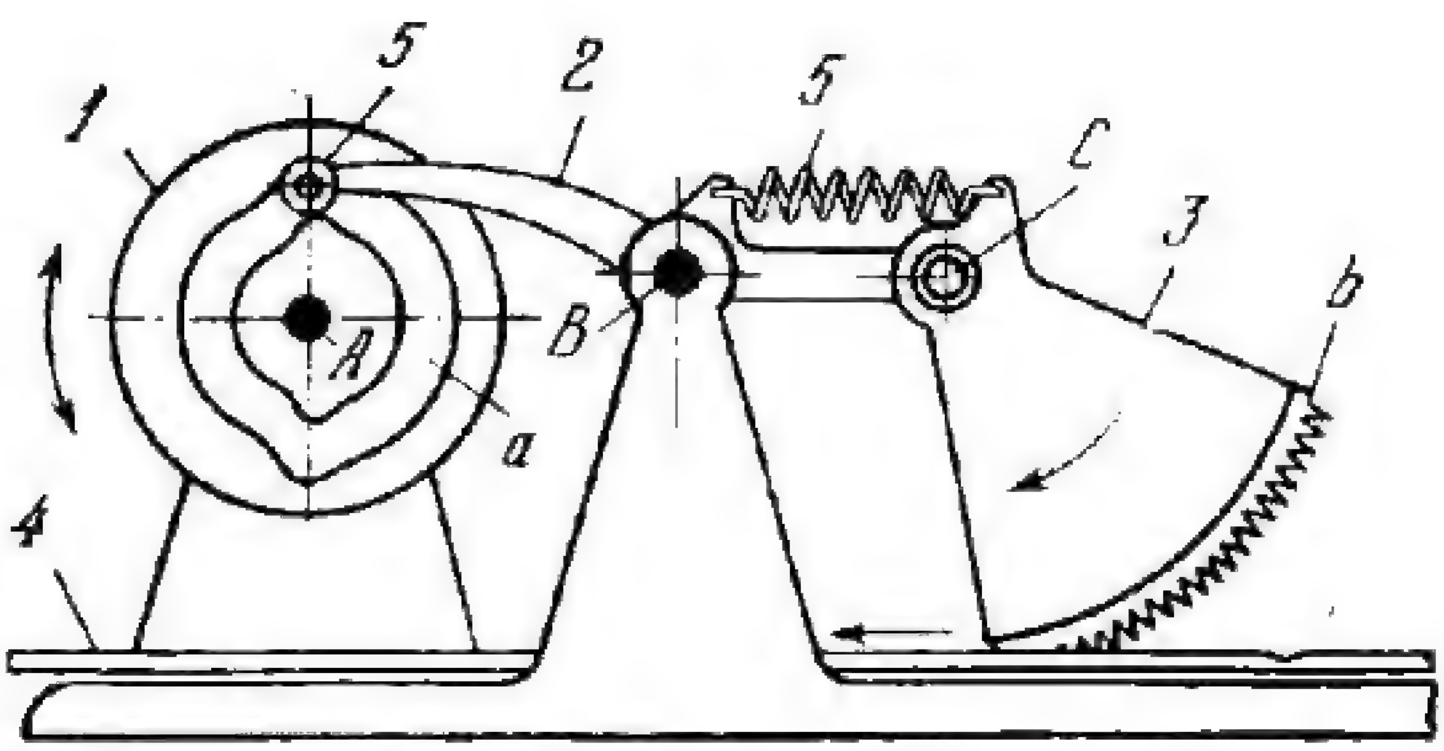
Cam *1* turns about fixed axis *A*. When cam *1* is turned clockwise, bar *2* is indexed in the position shown by dash lines. Bar *2* is returned to its initial position by spring *3* when cam *1* is turned counterclockwise.

3154	SLANTED-PLATE RIDGE CAM SPATIAL MECHANISM OF A PISTON MACHINE	SmC PM



Slanted-plate ridge cam *1* rotates about fixed axis *A-A*. Pistons *2* reciprocate in cylinders *3* along axes *B-B* which are parallel to axis *A-A*. Pistons *2* have slots *a* which engage the ridge of cam *1*.

3155	FOUR-LINK CAM-TYPE STRIP FEED MECHANISM	SmC SF



Face cam *1* rotates about fixed axis *A* and has profiled groove *a*. Follower *2* oscillates about fixed axis *B* and carries roller *5* which rolls and slides along groove *a*. Noncircular quadrant *3* is connected by turning pair *C* to follower *2*, has sharp serrations *b* and is oscillated by a separate mechanism (not shown). When cam *1* rotates, serrations of quadrant *3* engage and periodically advance strip *4*, thereby feeding the strip. Quadrant *3* is held in a definite position by spring *5*.

18. MECHANISMS OF OTHER FUNCTIONAL DEVICES
(3156 through 3171)

3156	THREE-LINK CAM MECHANISM OF AN ALLIGATOR SHEAR	SmC FD

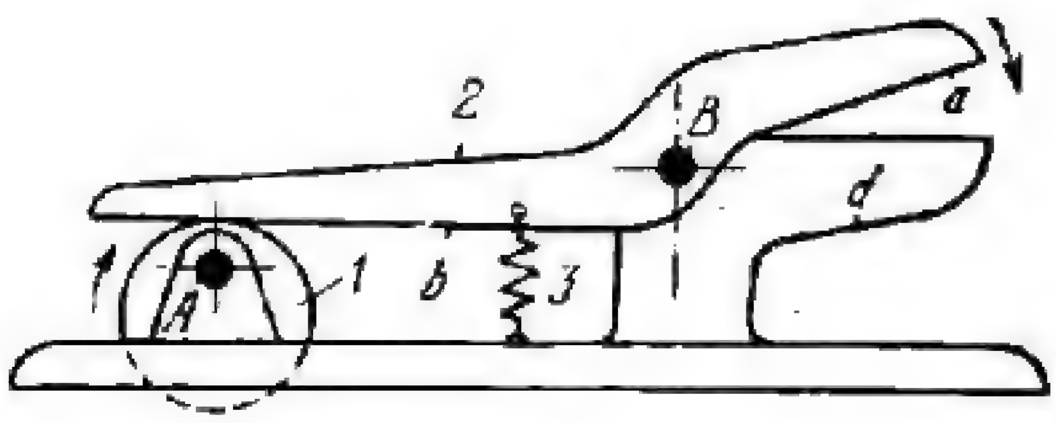
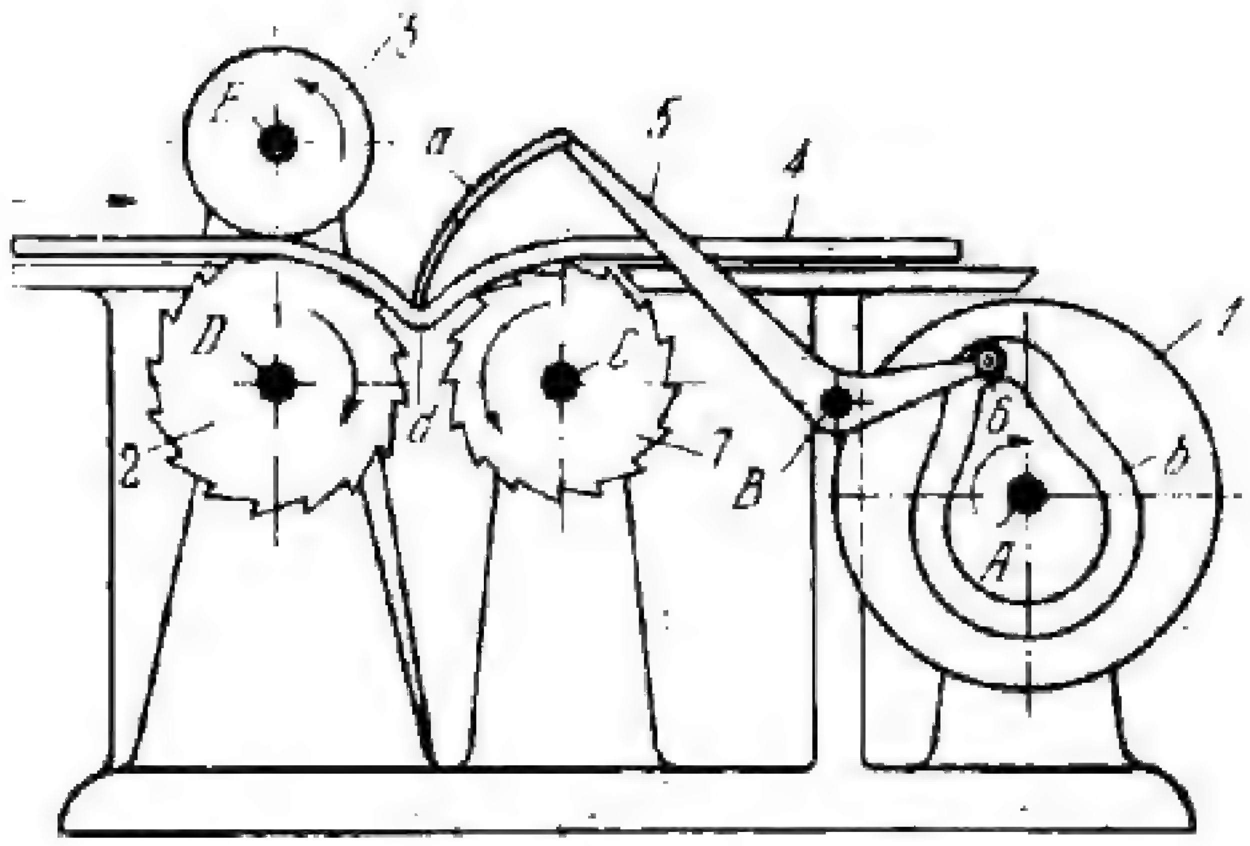


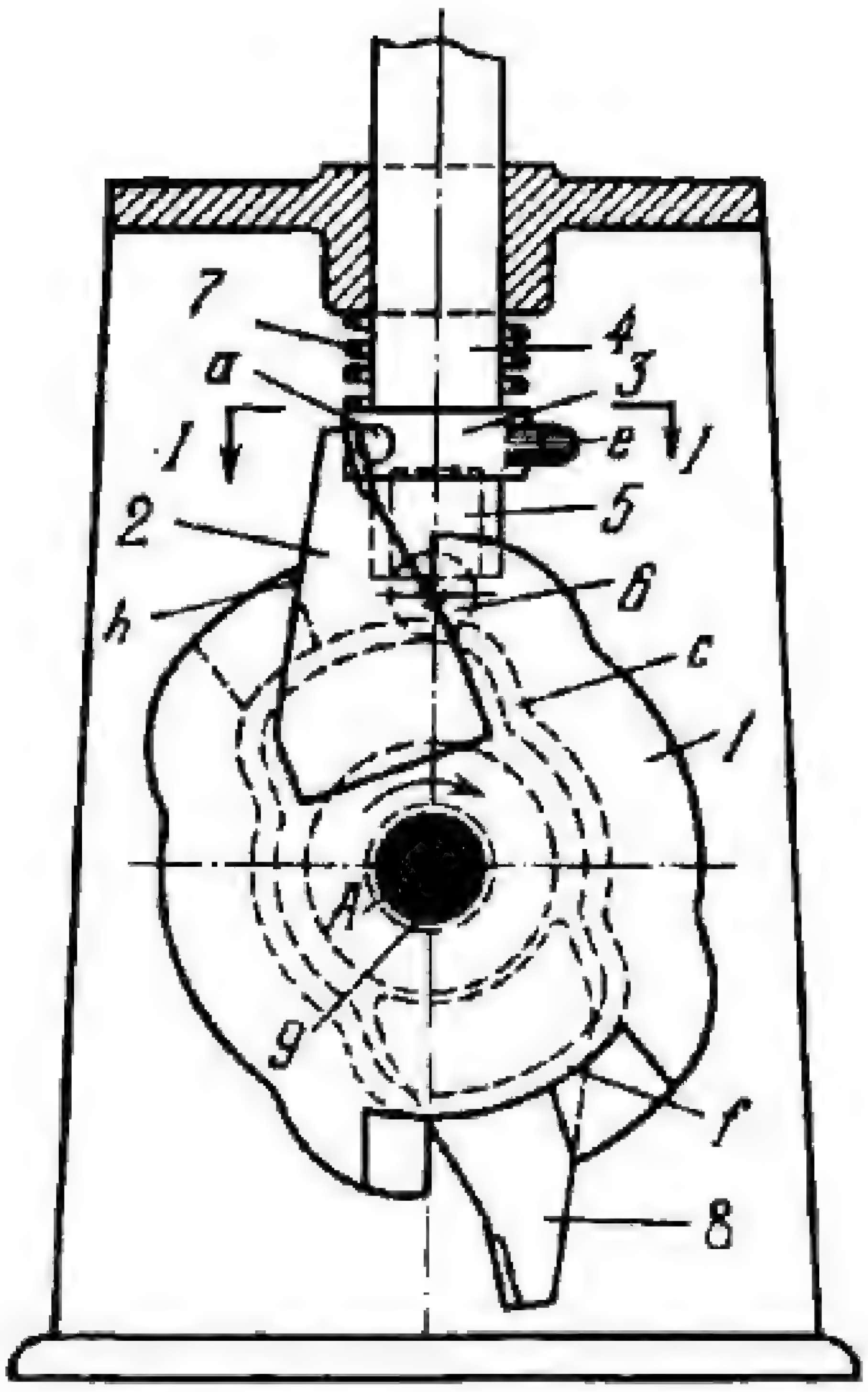
Plate cam *1* is a round eccentric and rotates about fixed axis *A*. Its working surface contacts flat surface *b* of link (follower) *2*, turning movable blade *a* of the shear about fixed axis *B* into contact with fixed blade *d*. Link *2* is held in contact with cam *1* by spring *3*.

3157	CAM-TYPE STRIP-CORRUGATING MECHANISM	SmC FD

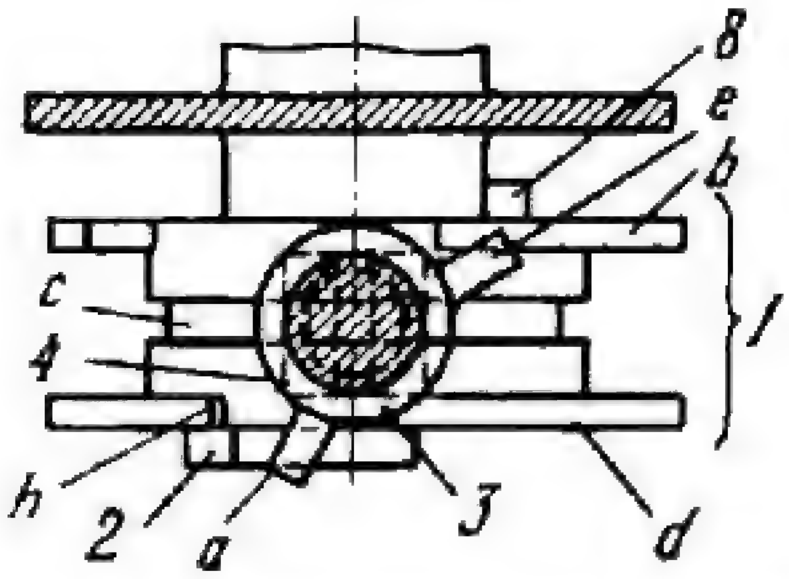


Face cam *1* rotates about fixed axis *A* and has profiled groove *b*. Follower *5* oscillates about fixed axis *B* and carries roller *6* which rolls and slides along groove *b*. Strip *4* is fed by smooth roll *3*, rotating about fixed axis *E*, and fluted roller *2*, rotating about fixed axis *D*. Roller *7* rotates about fixed axis *C*. Rollers *2* and *7* are rotated in opposite directions, while a trough is being formed in the strip, by means of a special mechanism (not shown). Follower *5* has finger *a* by means of which it periodically depresses moving strip *4*, forming bend *d*.

3158	DOUBLE-ACTION CAM MECHANISM FOR SIMULTANEOUSLY ROTATING A FOLLOWER AND MOVING IT AXIALLY	SmC FD

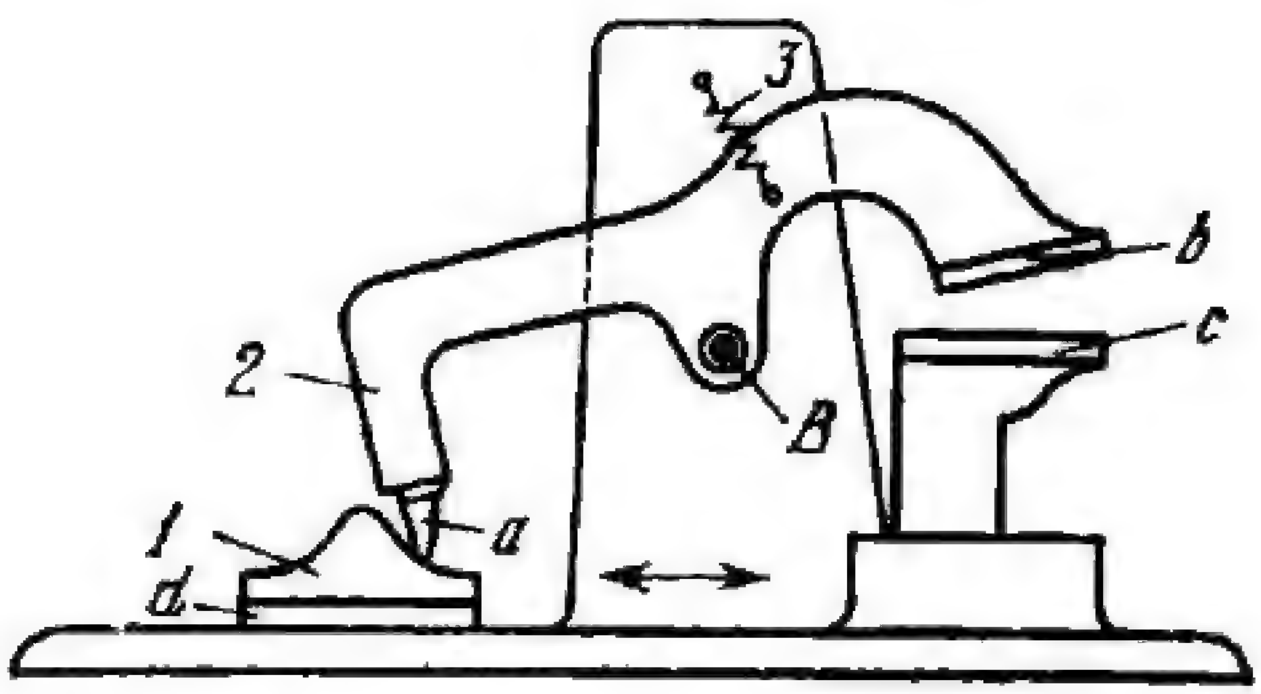


Section I-I



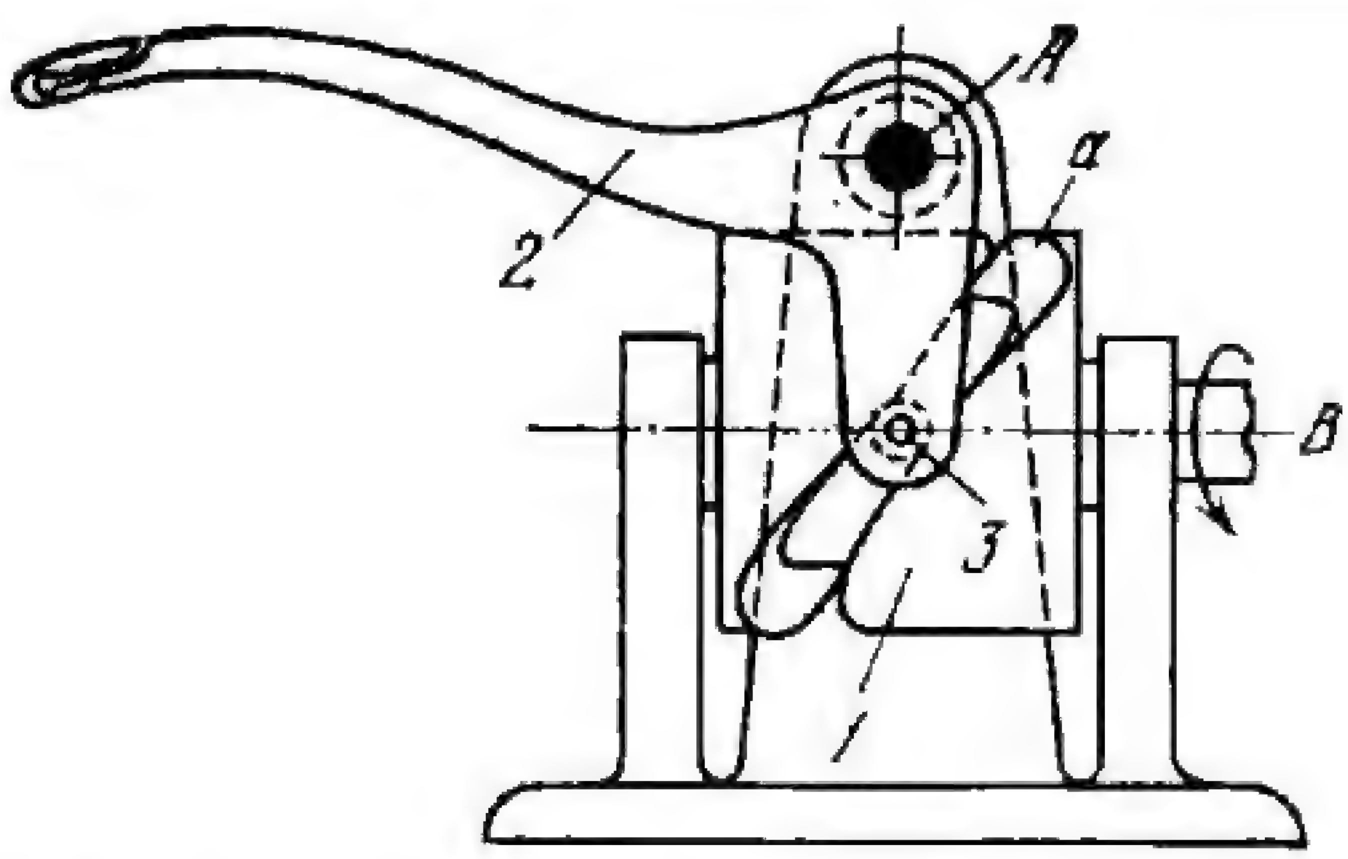
When cam 1 rotates clockwise about fixed axis A, finger 2 engages lug a of collar 3 and turns the collar together with vertical plunger 4. The plunger is rotated until end h of flange d on cam 1 comes in contact with the lower squared end of the plunger, continuing its rotation until it has completed its 90° movement. After this, the squared end enters between flanges b and d of cam 1, preventing further rotation. Plunger 4 turns with respect to plug 5 which is a free fit in a bore at the bottom of the plunger and carries roller 6. Roller 6 is constrained by continuous groove c of cam 1. As cam 1 rotates further, roller 6 rolls along its working surface and plunger 4 is shifted by spring 7 to its lower position. When the roller reaches portion f of the cam, plunger 4 is raised again and finger 8 engages lug e of collar 3, turning it back again together with plunger 4. The corresponding end of flange b now completes the 90° movement. Then plunger 4 is lowered again. Gaps are provided in the flanges at the required places to permit the square end of plunger 4 to rotate. Thus, to each revolution of shaft 9 to which cam 1 is keyed, plunger 4 has two upstrokes and two downstrokes, and is turned 90° twice, first in one direction and then back again, at its extreme upper position.

3159	CAM-OPERATED KNIFE MECHANISM OF A SEWING MACHINE	SmC FD



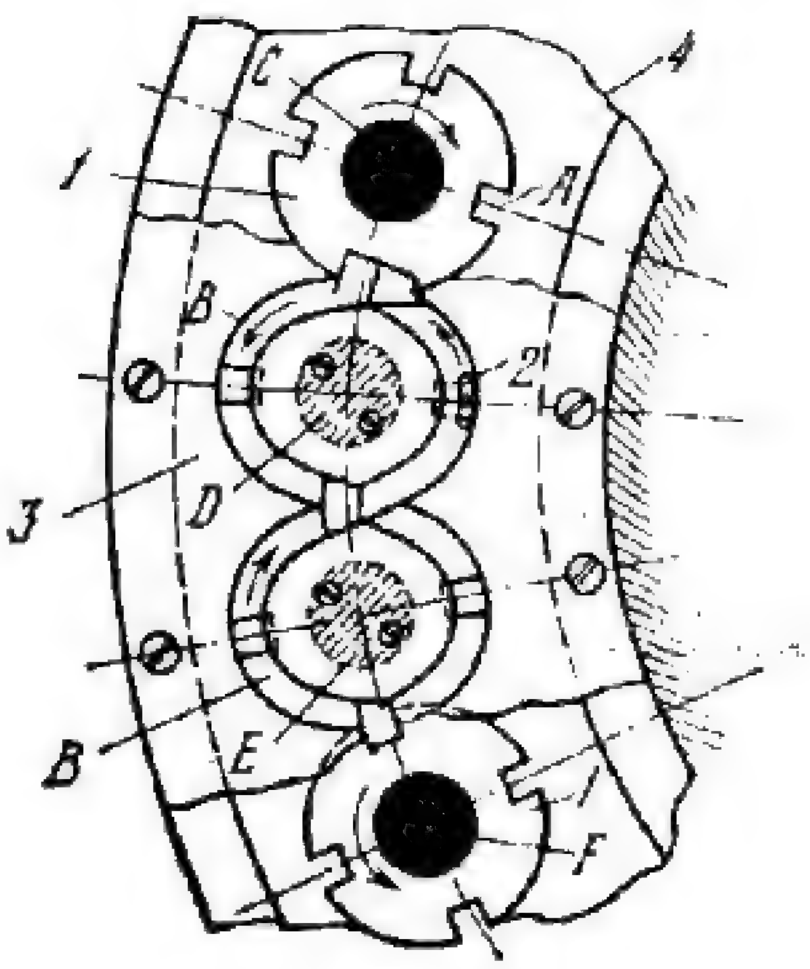
Sliding cam *1* reciprocates along fixed guide *d*. Knife lever (follower) *2* oscillates about fixed axis *B* and has tip *a* which slides along the working surface of cam *1*. When knife lever *2* is turned clockwise by cam *1*, upper knife *b* descends until it cuts the cloth which lies on movable shoe *c* which is operated by a separate mechanism (not shown). Lever *2* is returned to its initial position by spring *3*.

3160	THREE-LINK SPATIAL CAM-TYPE THREAD GUIDE MECHANISM	SmC FD



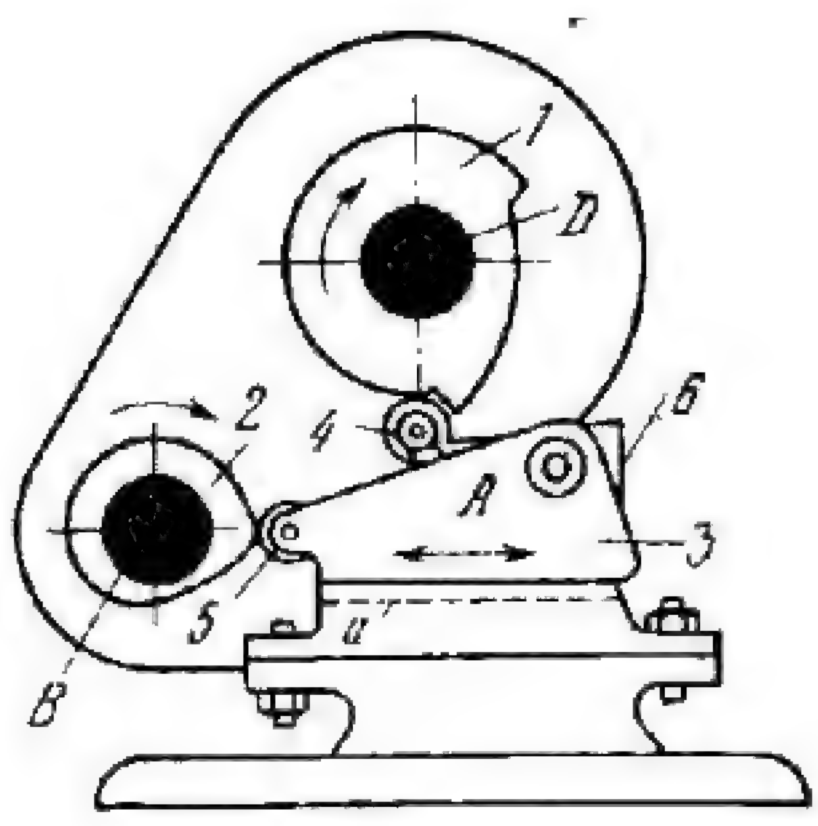
Thread guide *2* turns about fixed axis *A* and carries roller *3* which rolls and slides along groove *a* of cylinder cam *1*. Cam *1* rotates about fixed axis *B*. When cam *1* rotates, guide *2* has an oscillating motion. The required motion of the thread guide is obtained by proper design of groove *a*.

3161	CAM MECHANISM OF A LACE MACHINE	SmC FD



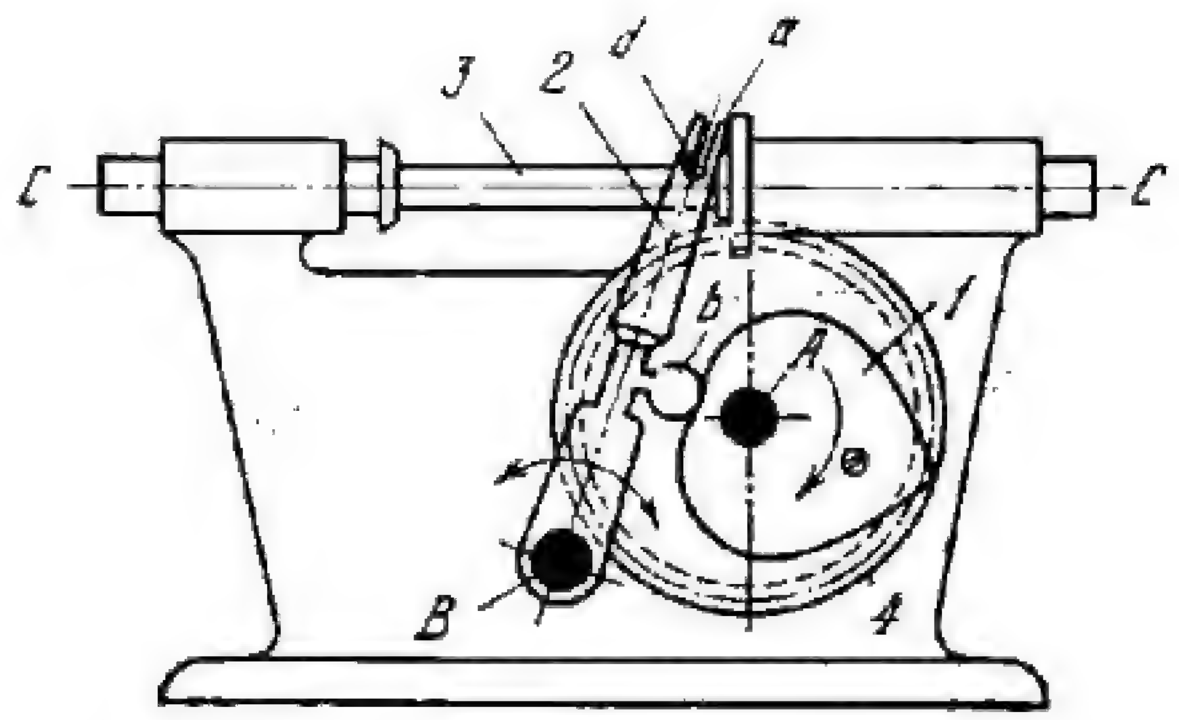
Arc-shaped member *3*, rigidly attached to fixed member *4*, has slots *B* of complex shape. Links *1*, located between members *3* and *4*, rotate about fixed axes *C*, *D*, *E* and *F*. As links *1* rotate, they engage runner *2* and move it along curvilinear guide slot *B* of member *3*. By rotation of links *1* in one or the other direction, and by changing the shape of slots *B*, the path of runner *2* can be changed so that different patterns of lace are obtained.

3162	CAM MECHANISM OF A CONTOUR TURNING ATTACHMENT	SmC FD



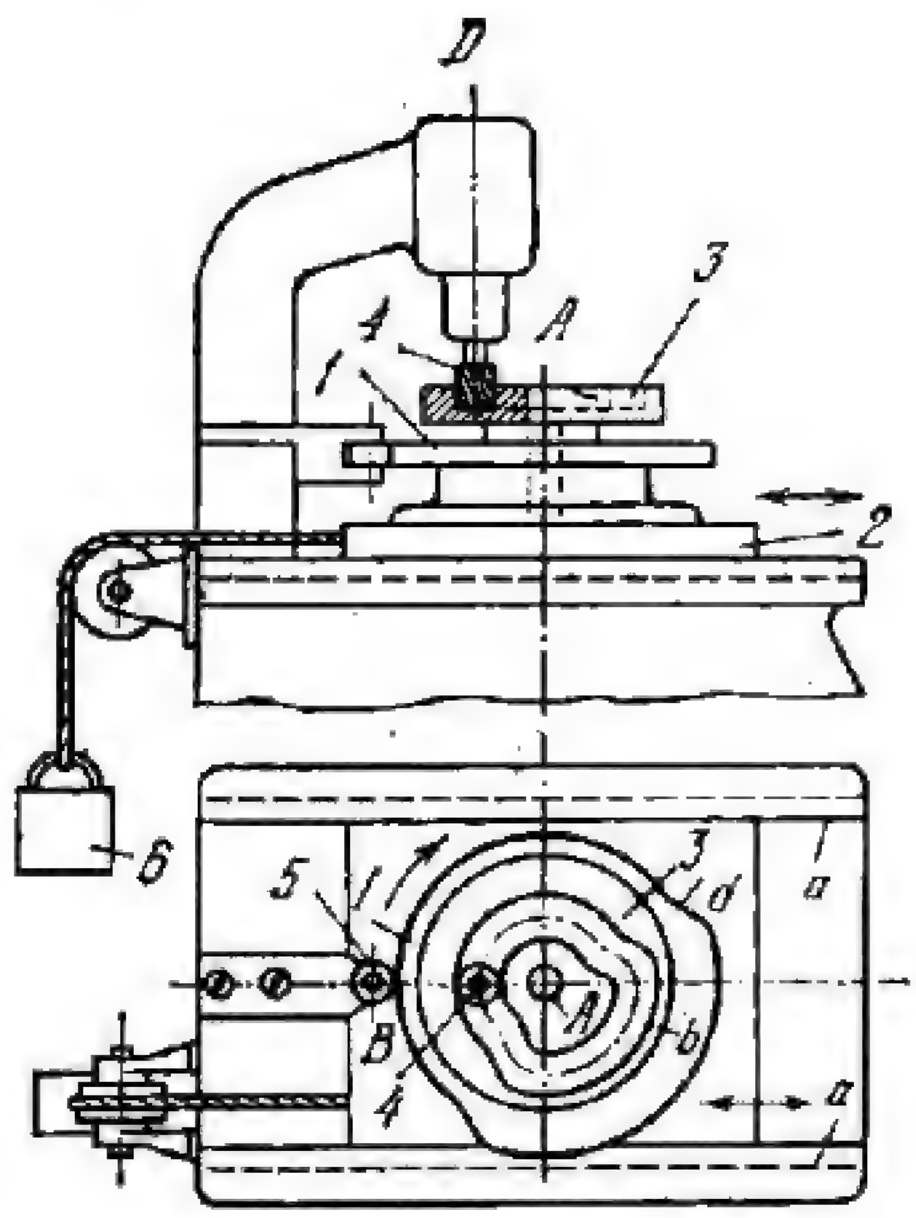
Cam *1* rotates about fixed axis *D* and cam *2* rotates about fixed axis *B*. Slide *3* of lathe tool *6* reciprocates along fixed guide *a* and carries roller *5* which rolls along the working surface of cam *2*. Tool *6* is clamped in a holder which oscillates about axis *A* of slide *3* and carries roller *4*. Roller *4* rolls along the working surface of cam *1*. Cam *2* controls the reciprocating movement of tool *6* so that it turns the required contour on the workpiece. Cam *1* controls the oscillation of tool *6* to maintain a constant cutting angle in turning contoured workpieces. Cams *1* and *2* are independently controlled by suitably programmed facilities.

3163	THREE-LINK CAM MECHANISM FOR WINDING THREAD ON A SPOOL OF A SEWING MACHINE	SmC FD



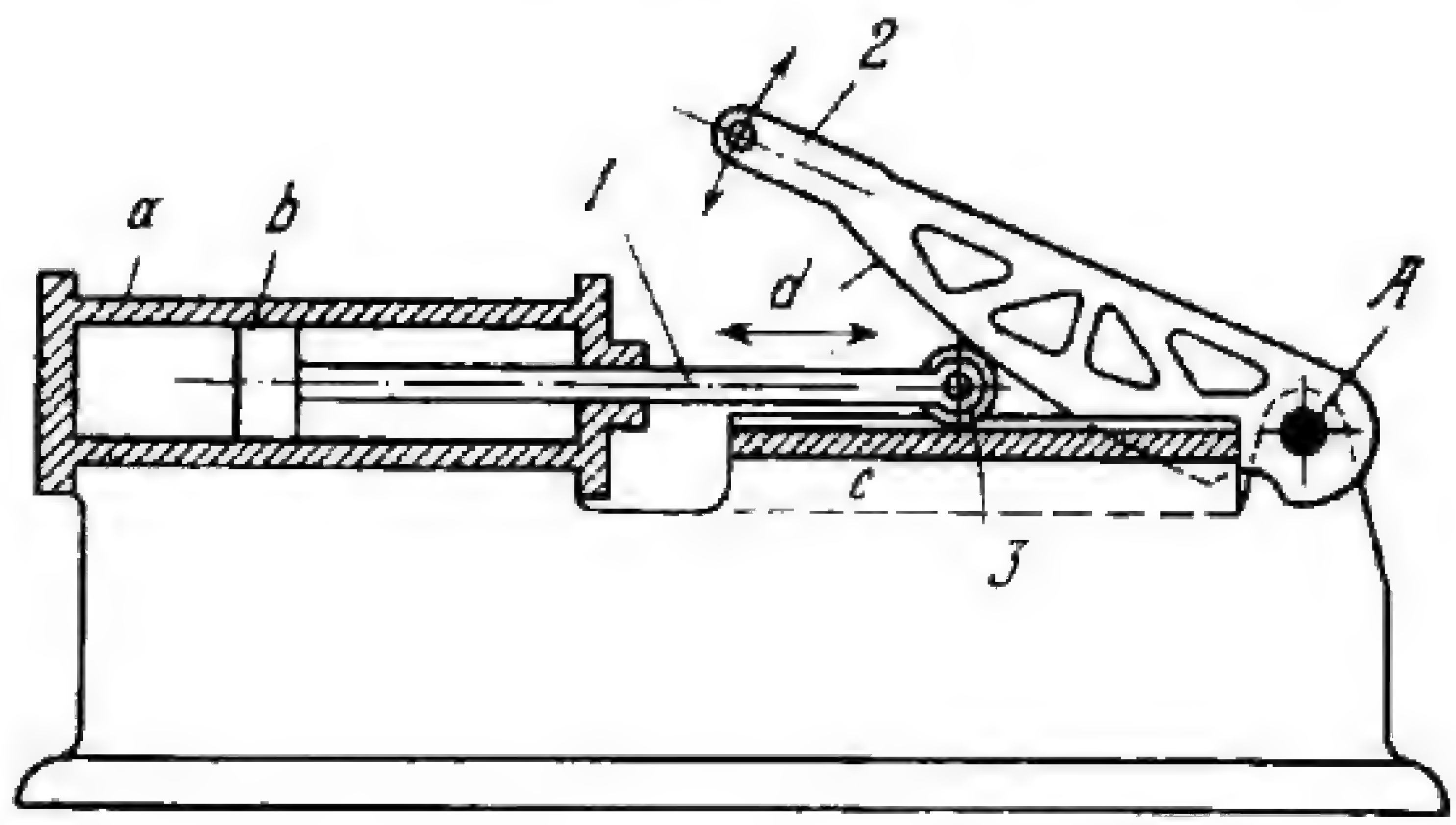
Cam *1* is rigidly attached to gear *4* and rotates about fixed axis *A*. Follower *2* oscillates about fixed axis *B* and has round lug *b* which slides along the working surface of cam *1*. The contour of cam *1* is along two symmetrical Archimedean spirals. Follower *2* has slot *d* which guides thread *a*. Thread *a* is wound on spool *3* which rotates about fixed axis *C-C*. The contour of cam *1* enables even layers of thread to be wound on the spool.

3164	CAM MECHANISM OF A PROFILE-MILLING MACHINE	SmC FD



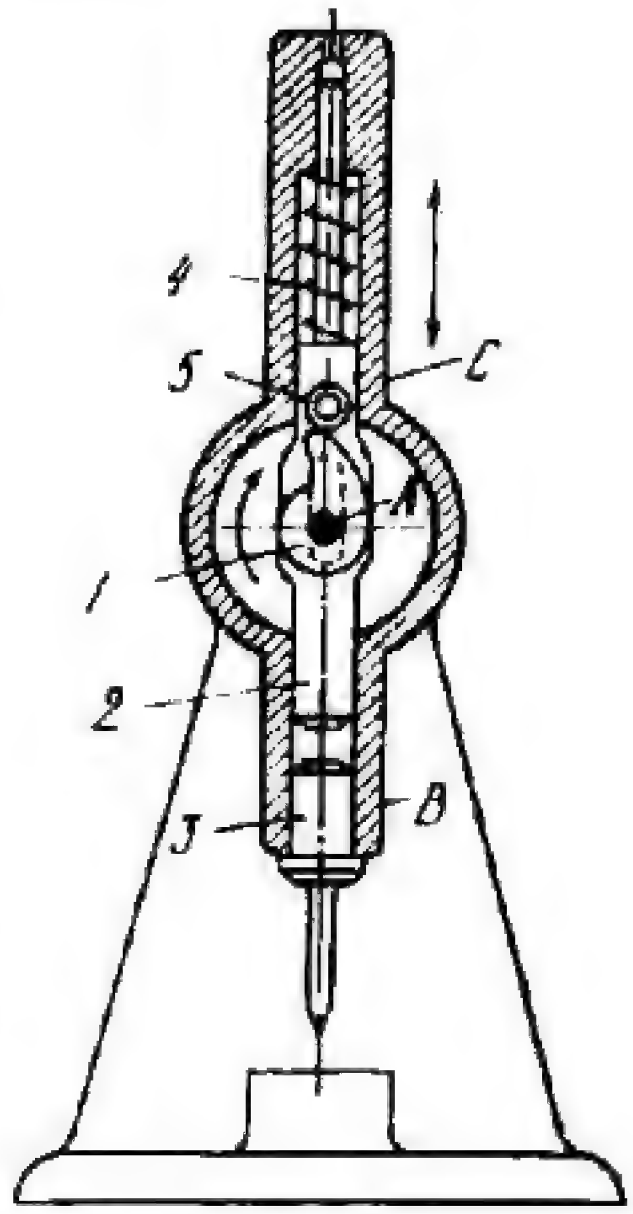
Template (cam) *1* rotates about axis *A* of machine table *2*. Roller *5* rotates about fixed axis *B*. Blank *3* is rigidly clamped to template *1* and rotates with it with respect to table *2*. When template *1* rotates, table *2* reciprocates in fixed guides *a-a* together with the template and blank *3*. End mill *4* rotates about fixed axis *D* and mills groove *b* in blank *3* to a profile corresponding to contour *d* of template *1*. Weight *6* holds template *1* in contact with roller *5*.

3165	THREE-LINK INVERSE CAM MECHANISM OF A DUMP TRUCK	SmC FD



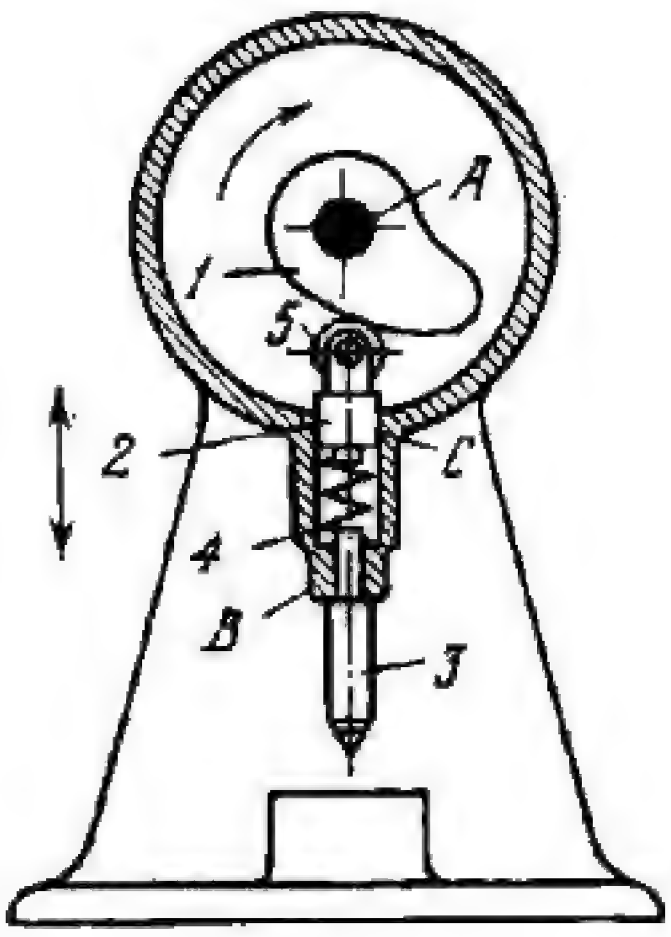
Piston b slides in hydraulic cylinder a and has rod 1 which carries roller 3. Roller 3 rolls along straight fixed guide c. Member 2, connected to the dump body of the truck, turns about fixed axis A and has profiled cam surface d along which roller 3 rolls and slides. When piston b moves to the right, the dump body is tipped; on the return stroke the body returns to its horizontal position.

3166	CAM MECHANISM OF A PUNCHING PRESS	SmC FD



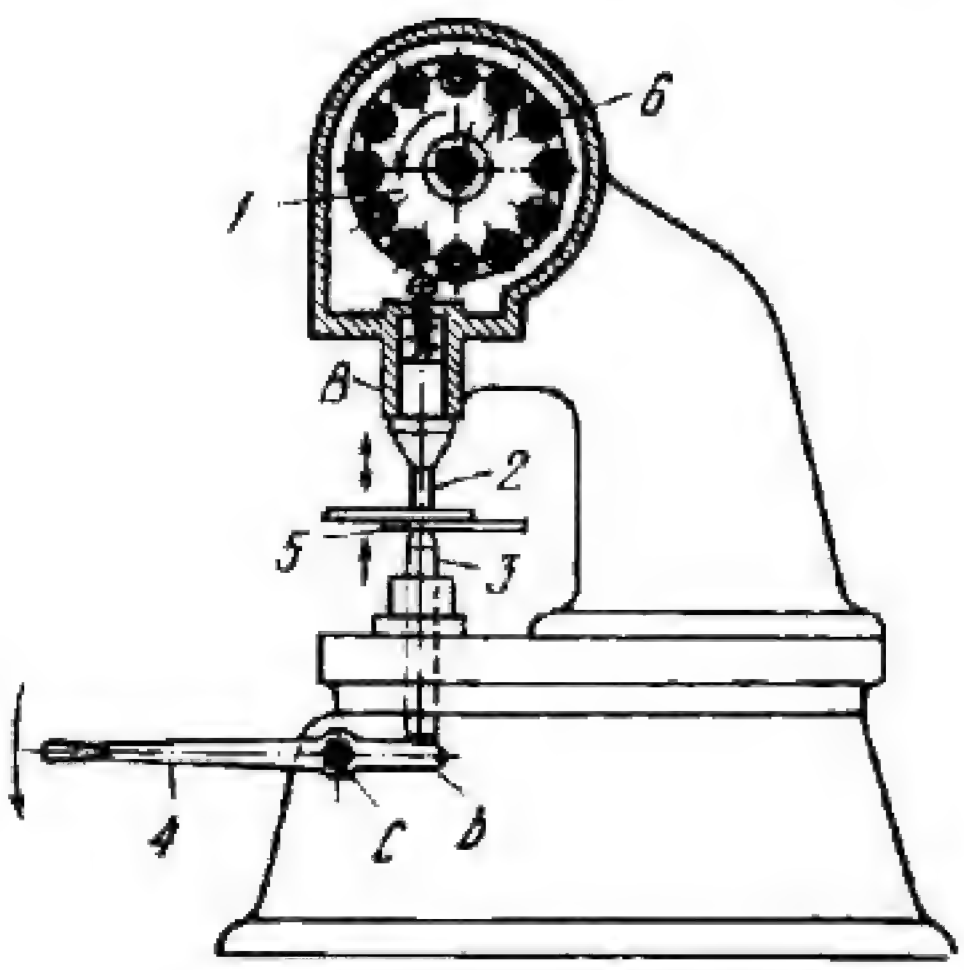
Cam 1 rotates about fixed axis A. Punch 3 slides in fixed guide B. Plunger (follower) 2 reciprocates in fixed guide C and carries roller 5 which rolls along the working surface of cam 1. Plunger 2 is actuated by spring 4. When cam 1 rotates, roller 5 is raised by the cam and then suddenly dropped so that spring 4 pushes plunger 2 which strikes punch 3 and makes a hole in the stock.

3167	CAM MECHANISM OF A PUNCHING PRESS	SmC FD



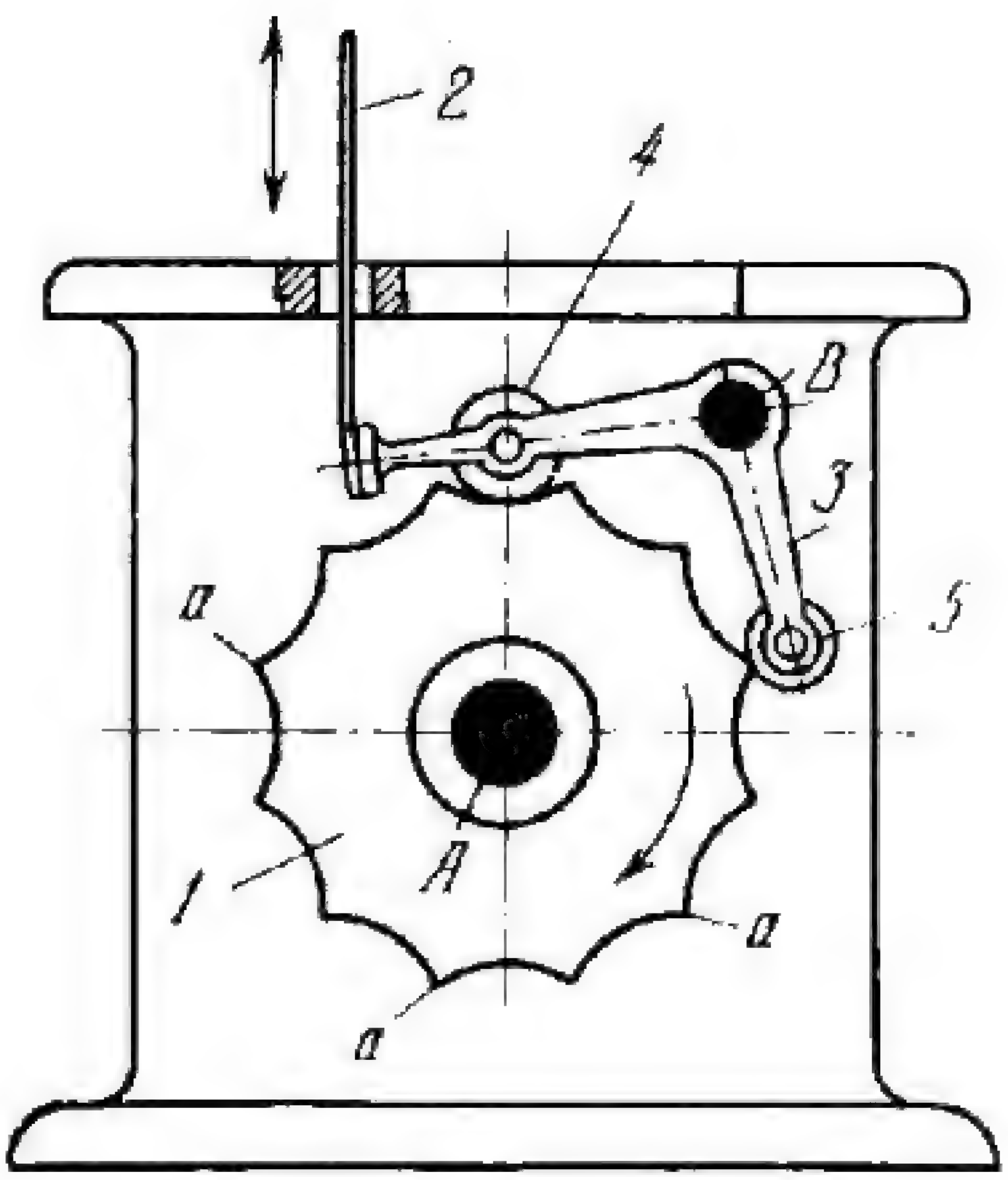
Cam *1* rotates about fixed axis *A*. Punch *3* slides in fixed guide *B*. Plunger (follower) *2* reciprocates in fixed guide *C* and carries roller *5* which rolls along the working surface of cam *1*. Spring *4* is arranged between plunger *2* and punch *3*. When cam *1* rotates, plunger *2* compresses spring *4* and strikes punch *3* which makes a hole in the stock.

3168	CAM MECHANISM OF A PIN-WHEEL RIVETING MACHINE	SmC FD



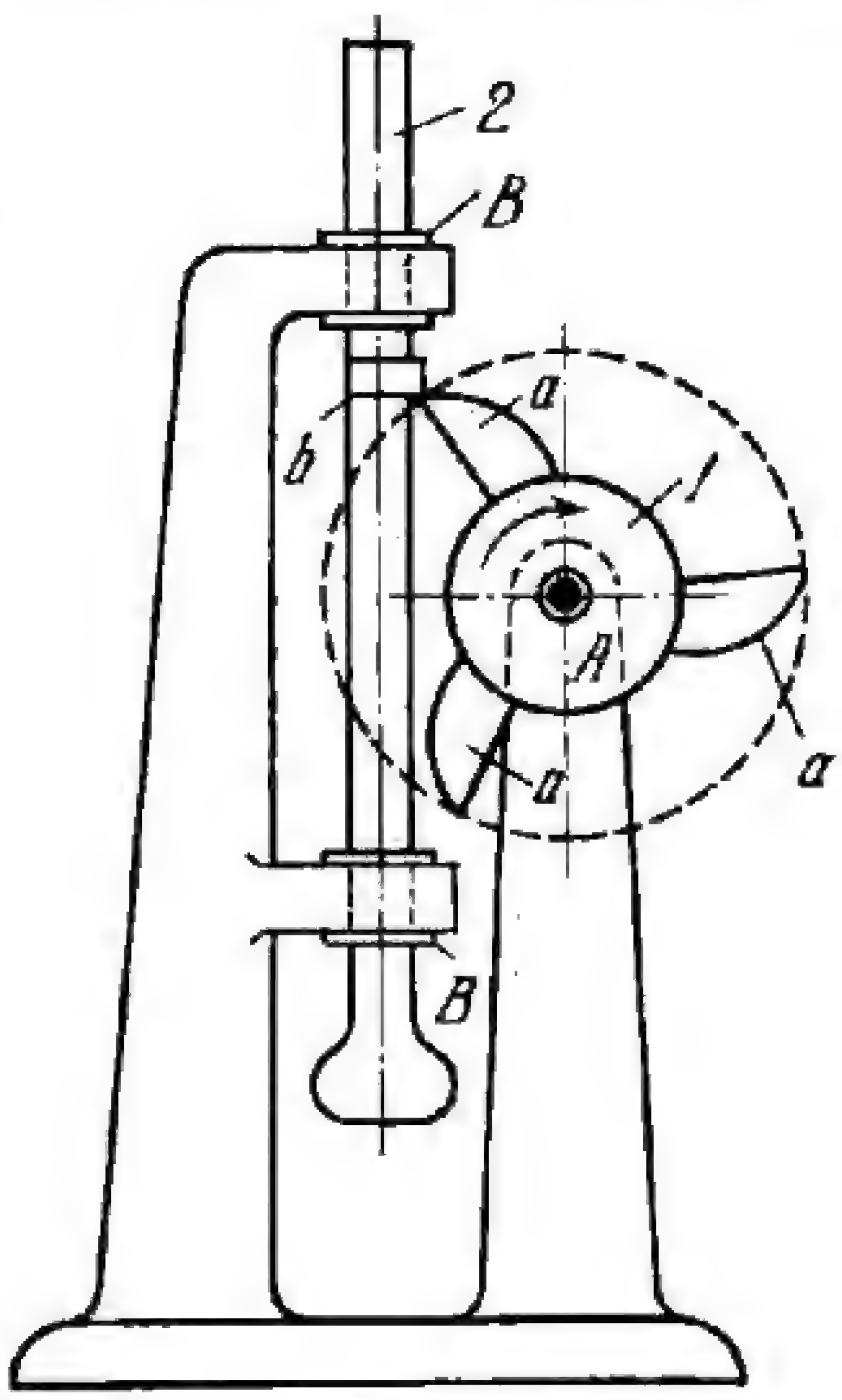
Wheel *1* rotates about fixed axis *A* and carries twelve roller-type pins *6*. Spring-loaded rivet snap *2* reciprocates in fixed guide *B*. Lever *4* turns about fixed axis *C* and its end *b* acts on rivet dolly *3*. By turning lever *4* counterclockwise, the sheets *5* to be riveted, together with snap *2* and dolly *3*, are raised until pins *6* of wheel *1* strike rivet snap *2* with a series of blows.

3169	CAM-TYPE JIG SAW MECHANISM	SmC FD



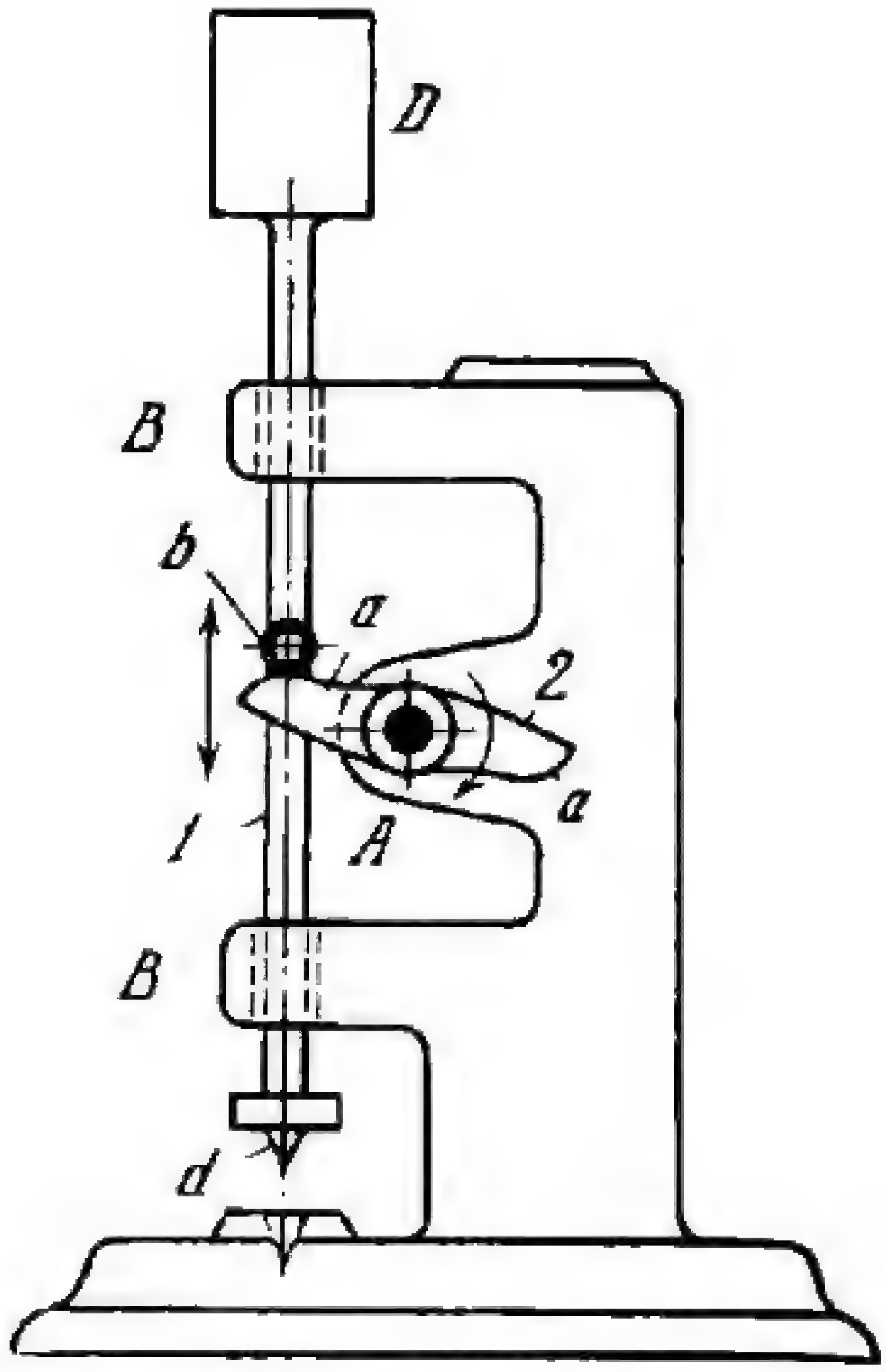
Cam *1* rotates about fixed axis *A* and has twelve lobes *a*. Follower *3* oscillates about fixed axis *B* and carries rollers *4* and *5* which are located so that when roller *5* is on a lobe *a* of cam *1*, roller *4* is in a recess between adjacent lobes, and vice versa. Flexibly attached to follower *3* is saw blade *2* which is reciprocated vertically to obtain the sawing motion. In one revolution of cam *1*, saw blade *2* has twelve upstrokes and twelve downstrokes.

3170	THREE-LINK CAM-TYPE STAMPING MILL MECHANISM	SmC FD



Cam *1* rotates about fixed axis *A* and has three symmetrically located identical profiled lobes *a*. Stamp *2* reciprocates in fixed guides *B-B* and has flat lug *b* along whose surface the working surfaces of lobes *a* slide while the stamp is being raised. When a lobe *a* turns out of engagement with lug *b*, the stamp drops and is then raised again by the next lobe *a* engaging lug *b*.

3171	THREE-LINK CAM MECHANISM OF A PUNCHING PRESS	SmC FD



Cam *2* rotates about fixed axis *A* and has two lobes with profiled working surfaces *a*. Ram *1* reciprocates in fixed guides *B*-*B* and has punch *d* for making holes in the stock. Pin *b* on ram *1* comes into contact periodically with one of working surfaces *a* of cam *2*. When the cam lobe turns out of engagement with pin *b*, ram *1* with weight *D* at its upper end drops and punches a hole in the stock. In one revolution of cam *2*, ram *1* is raised twice and dropped twice.

SECTION TWENTY-ONE

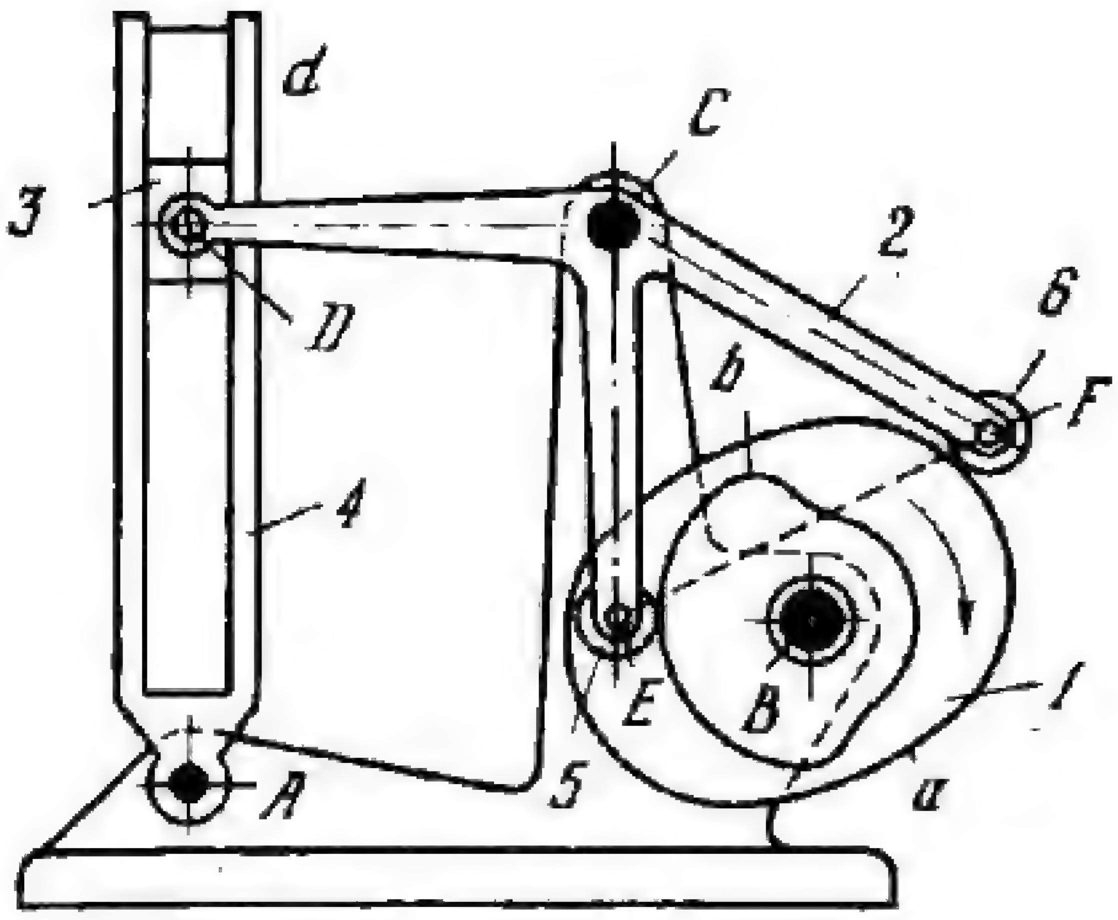
Cam-Lever Mechanisms

CmL

1. General-Purpose Multiple-Link Mechanisms ML (3172 through 3190)
2. Dwell Mechanisms D (3191 through 3195)
3. Mechanisms for Generating Curves Ge (3196, 3197 and 3198)
4. Mechanisms for Mathematical Operations MO (3199 through 3205)
5. Operating Claw Mechanisms of Motion Picture Cameras OC (3206 through 3217)
6. Hammer, Press and Die Mechanisms HP (3218 through 3223)
7. Gripping, Clamping and Expanding Mechanisms GC (3224 through 3229)
8. Link-Length Adjustment Mechanisms LL (3230 through 3238)
9. Sorting and Feeding Mechanisms SF (3239 through 3256)
10. Mechanisms of Materials Handling Equipment MH (3257)
11. Mechanisms of Measuring and Testing Devices M (3258, 3259 and 3260)
12. Clutch and Coupling Mechanisms C (3261 and 3262)
13. Piston Machine Mechanisms PM (3263 through 3266)
14. Switching, Engaging and Disengaging Mechanisms SE (3267, 3268 and 3269)
15. Mechanisms of Other Functional Devices FD (3270 through 3297)

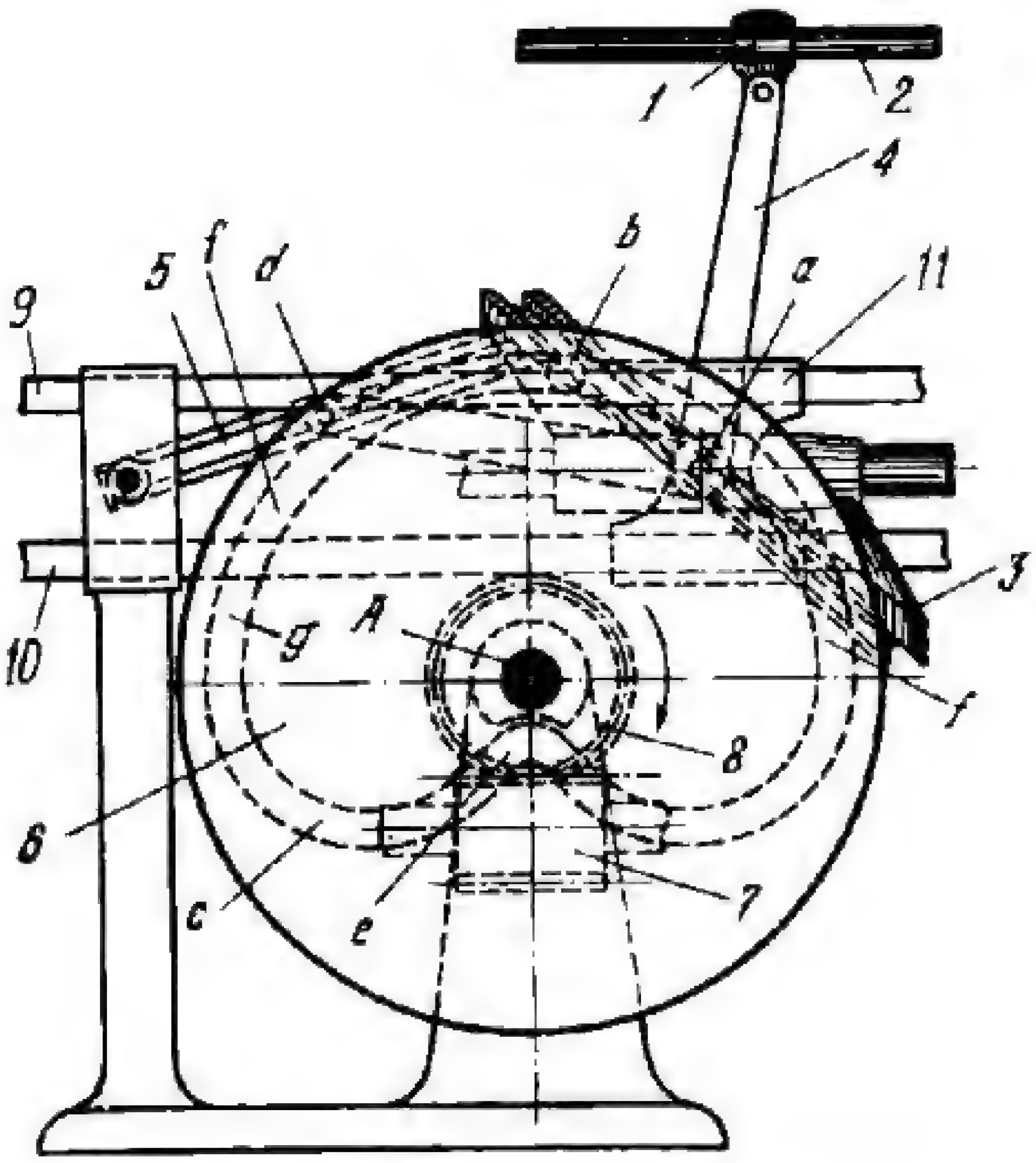
1. GENERAL-PURPOSE MULTIPLE-LINK MECHANISMS
(3172 through 3190)

3172	MAIN-AND-RETURN CAM-LEVER MECHANISM	CmL ML



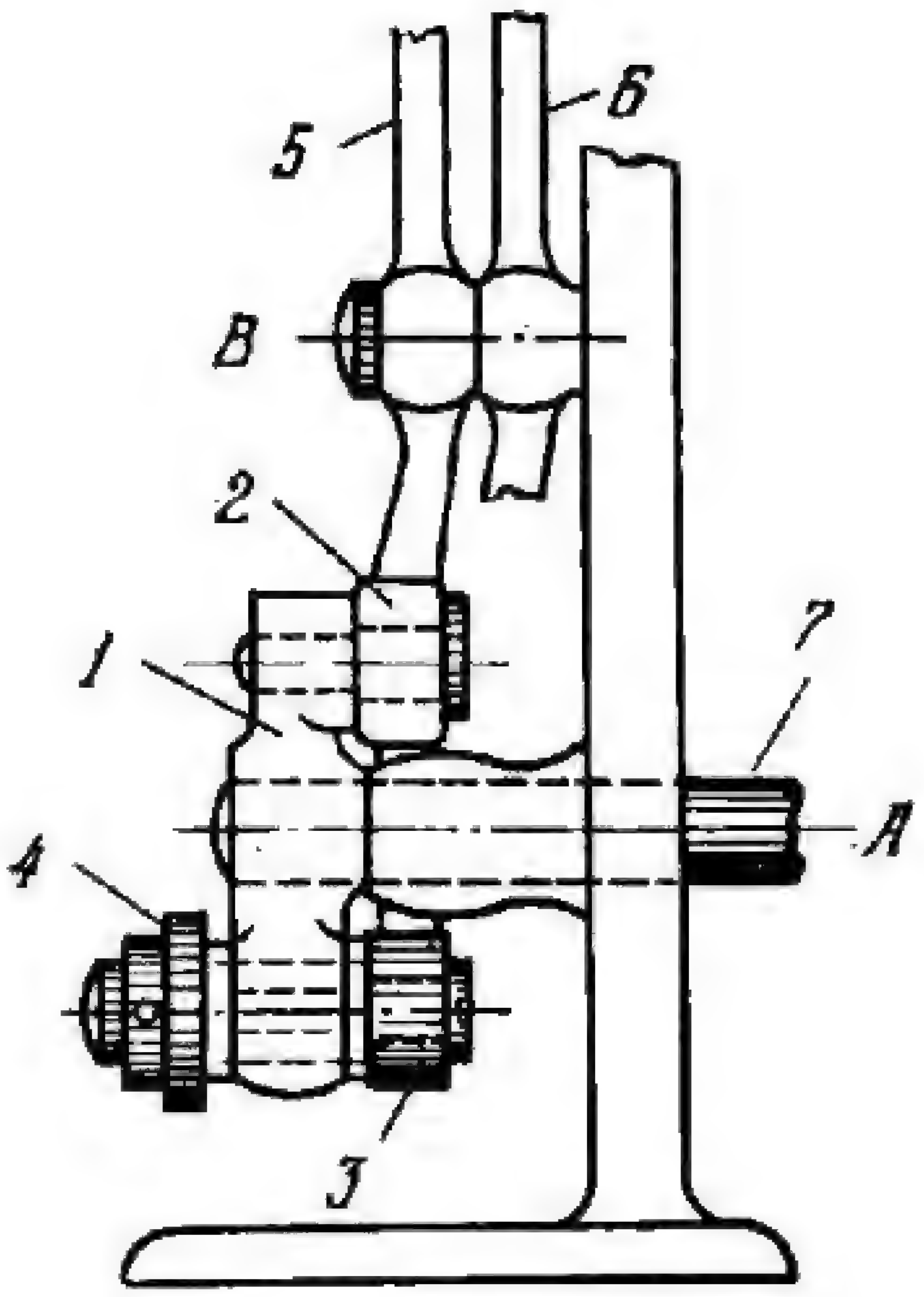
Cam *1* rotates about fixed axis *B* and has two contours, *a* and *b*. Follower *2* oscillates about fixed axis *C* and carries two rollers, *5* and *6*, which roll along the contours of cam *1*: roller *5* along contour *b* and roller *6* along contour *a*. Follower *2* is connected by turning pair *D* to slider *3* which reciprocates along slot *d* of link *4*. Link *4* oscillates about fixed axis *A*. Positive motion is achieved because the distance between points *E* and *F*, lying on the theoretical, or pitch, curves of contours *b* and *a*, is constant and equal to the distance between the centres of rollers *5* and *6*.

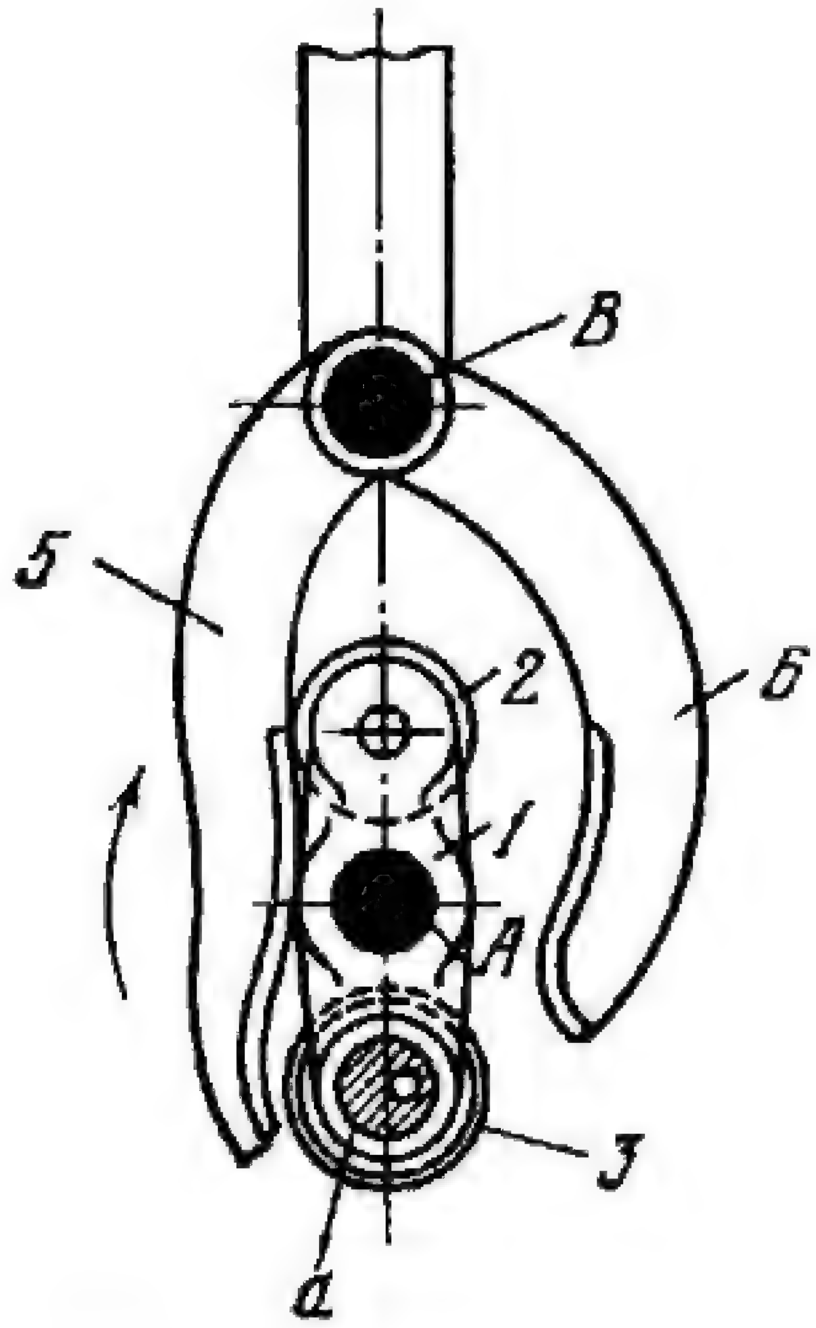
3173	SPATIAL CAM-LEVER MECHANISM WITH VARIABLE STROKE OF A RECIPROCATING GUIDING MEMBER	CmL ML



Guiding member *1* is reciprocated along fixed guide *2* by cross-head *11* through bellcrank lever *4* which is pivoted to the cross-head at *a*. Cross-head *11* slides along fixed bars *9* and *10*, and is reciprocated by cam *3* in whose groove roller *a* of the cross-head rolls and slides. Roller *d*, at the lower end of bellcrank lever *4*, engages the slot of pivoted lever *5*. The stroke of member *1* depends upon the angle of inclination of slotted lever *5*. This angle of lever *5* is controlled by cam *6* in whose groove *g* roller *b* of lever *5* rolls and slides. Cam *6* rotates about fixed axis *A* and is driven by worm *7* and worm wheel *8*. While roller *b* of lever *5* is passing over concentric circular portion *f* of groove *g* in cam *6*, lever *5* has a dwell and guiding member *1* has its maximum stroke. Then the stroke is gradually diminished as roller *b* passes along portion *c* of groove *g*, reaching its minimum value at point *e*. After this point, the stroke of member *1* gradually increases again.

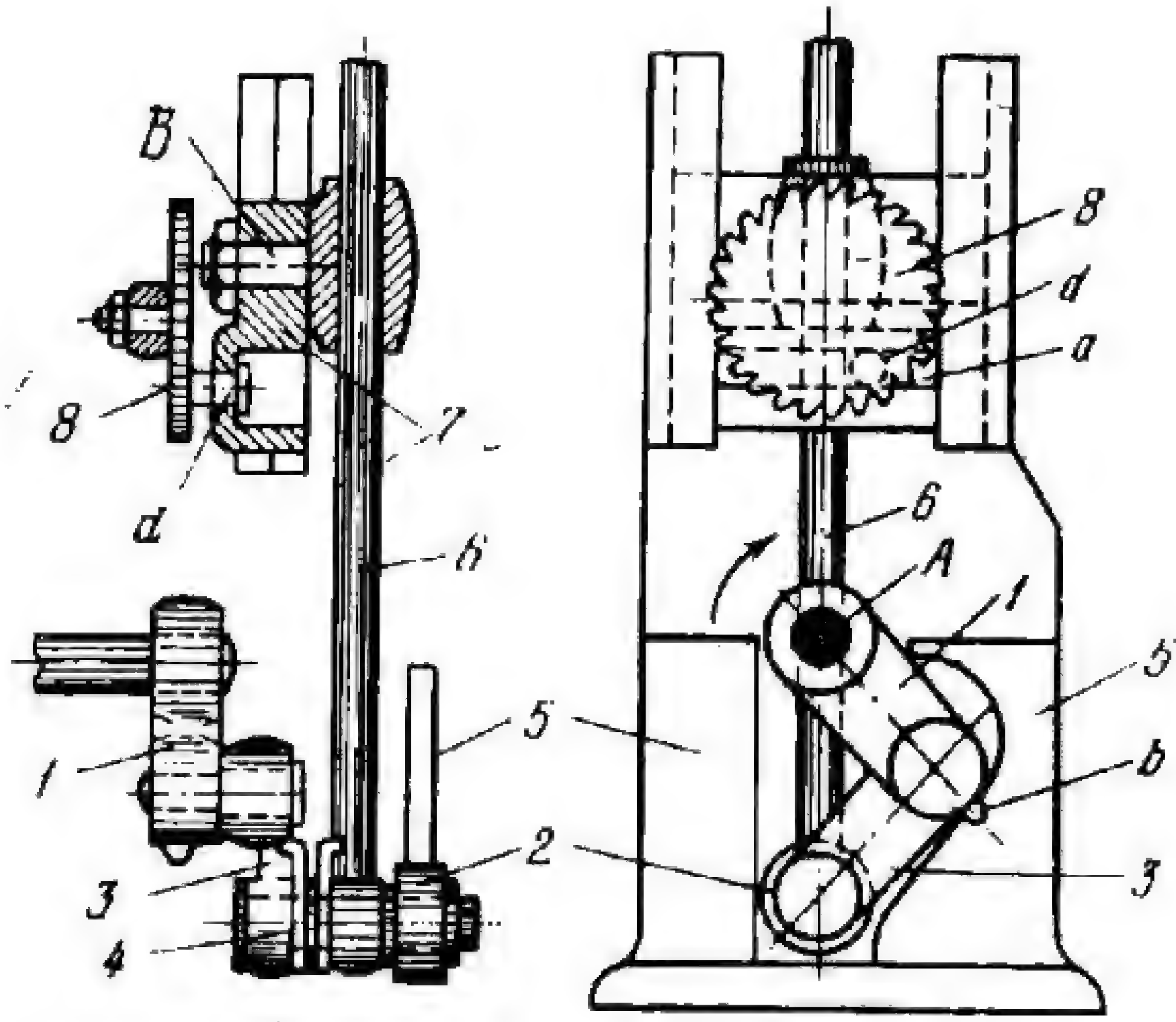
3174	CAM-LEVER MECHANISM WITH VARIABLE AMPLITUDE OF OSCILLATION OF THE DRIVEN LINKS	CmL ML





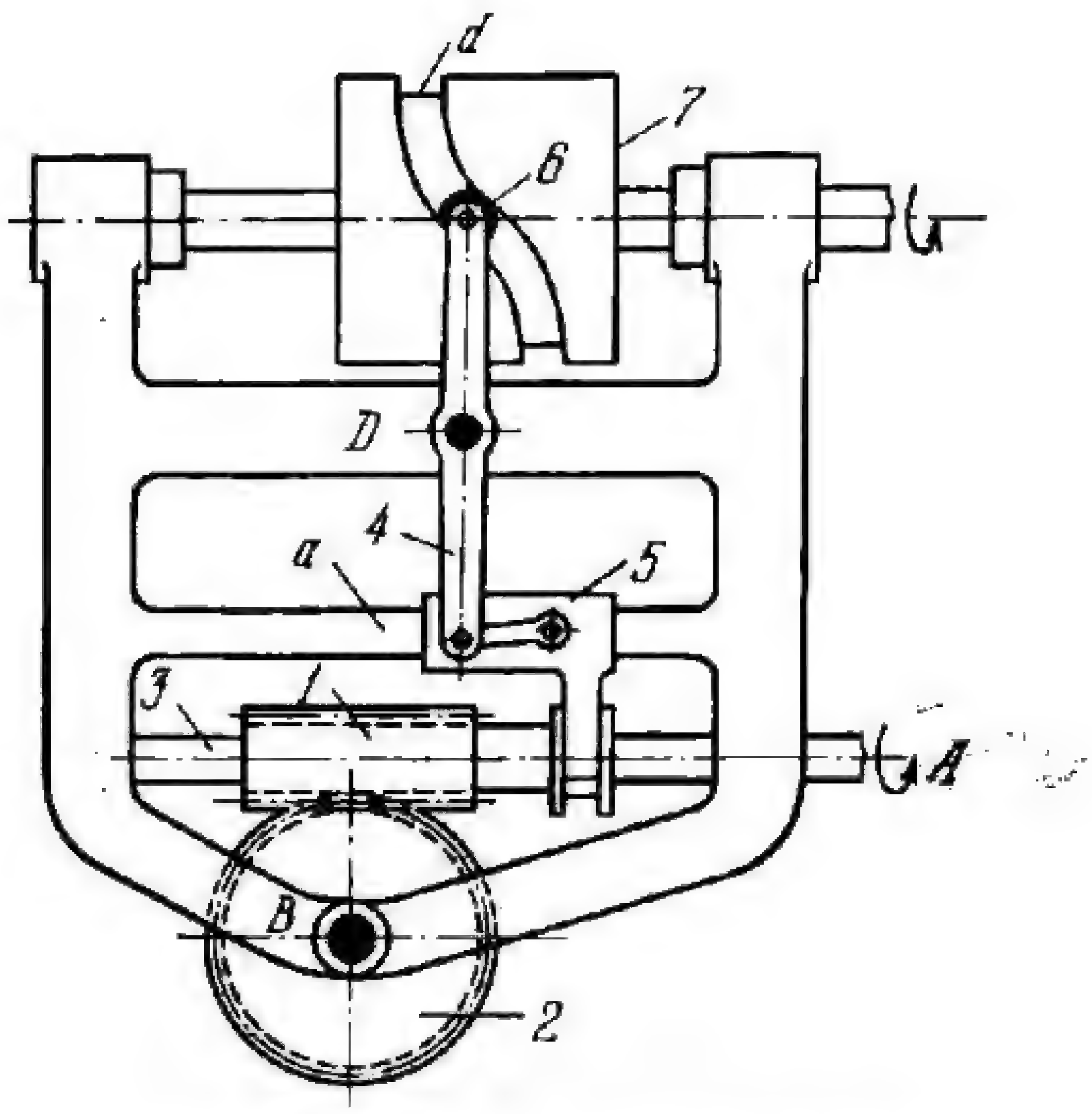
Arm *1* is keyed to shaft *7* and rotates clockwise about fixed axis *A*. Pivoted to the ends of arm *1* are concentrically mounted roller *2* and eccentrically mounted roller *3*. By means of ratchet device *4*, bushing *a*, on which roller *3* is eccentrically mounted, is periodically turned through a definite angle, so that roller *3* is moved either toward or away from axis *A*. When roller *2* engages the suitably profiled cam surfaces of levers (followers) *5* and *6*, which oscillate about fixed axis *B*, the levers have a constant amplitude. The amplitudes of levers *5* and *6* gradually vary when they are engaged by roller *3*.

3175	CAM-LEVER MECHANISM WITH VARIABLE DRIVEN LINK OSCILLATION	CmL ML



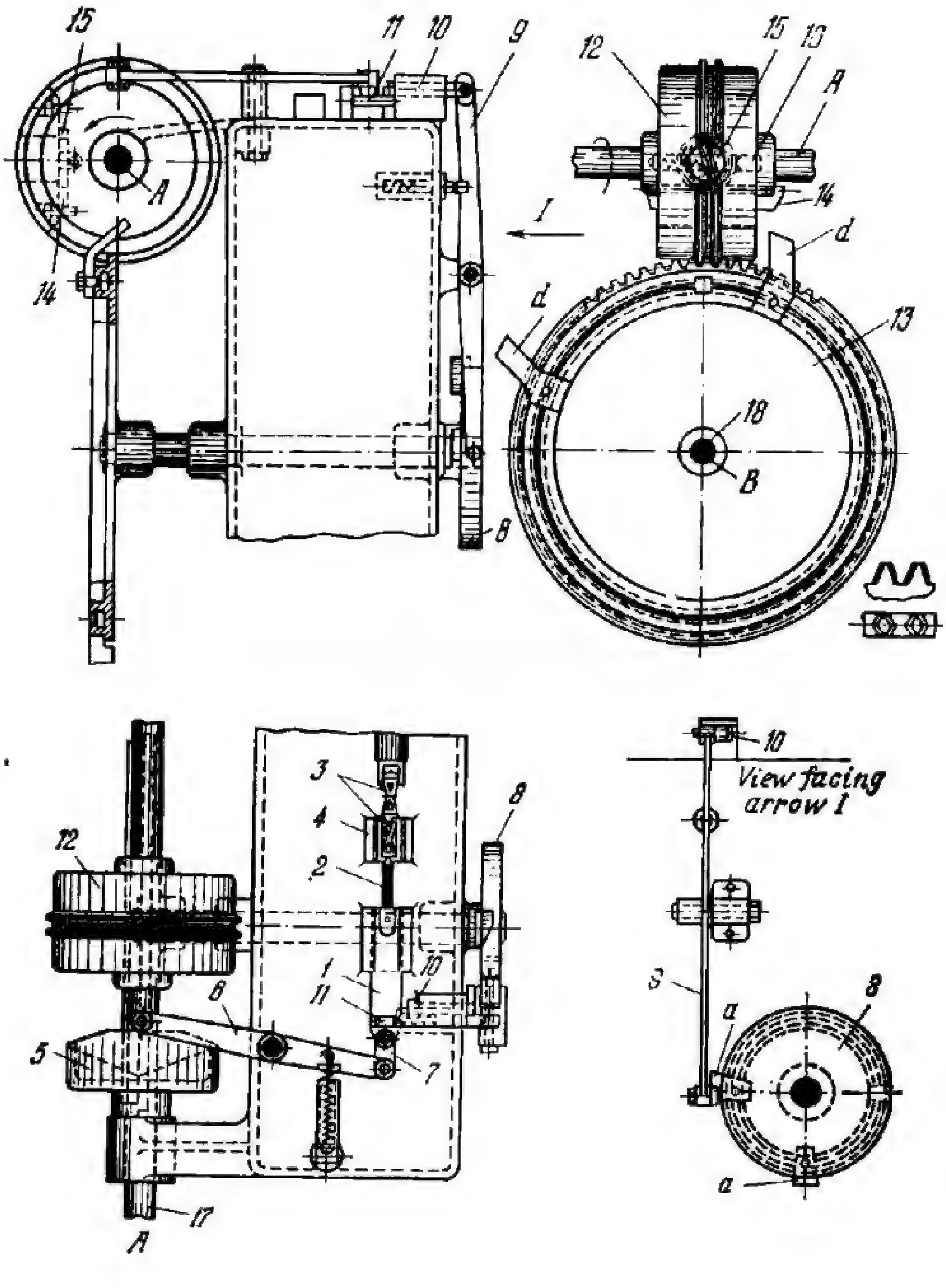
When crank *1* rotates about fixed axis *A*, motion is imparted to roller *2* through connecting link *3*. Spring *4* holds roller *2* in contact with the working surfaces of fixed plate cam *5*. This gives rod *6* a turning motion about axis *B* and reciprocating motion with respect to slotted cross-head *7*. Roller *d* of ratchet wheel *8* slides along the slot in cross-head *7*. In each revolution of crank *1*, its lug *b* engages and turns ratchet wheel *8* through an angle corresponding to one tooth, gradually raising and lowering axis *B*. This varies the motion of rod *6* derived from cam *5*.

3176	CAM-LEVER SPATIAL MECHANISM FOR PERIODICALLY VARYING ANGULAR VELOCITY	CmL ML



Worm *1* rotates about axis *A* and can slide along this axis on shaft *3* along a feather key. Worm *1* drives worm wheel *2* about fixed axis *B*. Worm *1* is reciprocated by lever *4* which oscillates about fixed axis *D* and carries roller *6*. Lever *4* is connected by an intermediate link to slide *5* which reciprocates along fixed guide *a*, whose axis is parallel to axis *A*, and is connected by a turning pair to worm *1*. Roller *6* of lever *4* rolls and slides along groove *d* of cylinder cam *7* which is rotated by a separate drive. If the profile of groove *d* is properly designed and the speed of cam *7* suitably selected, the angular velocity of wheel *2* can be varied periodically within definite limits.

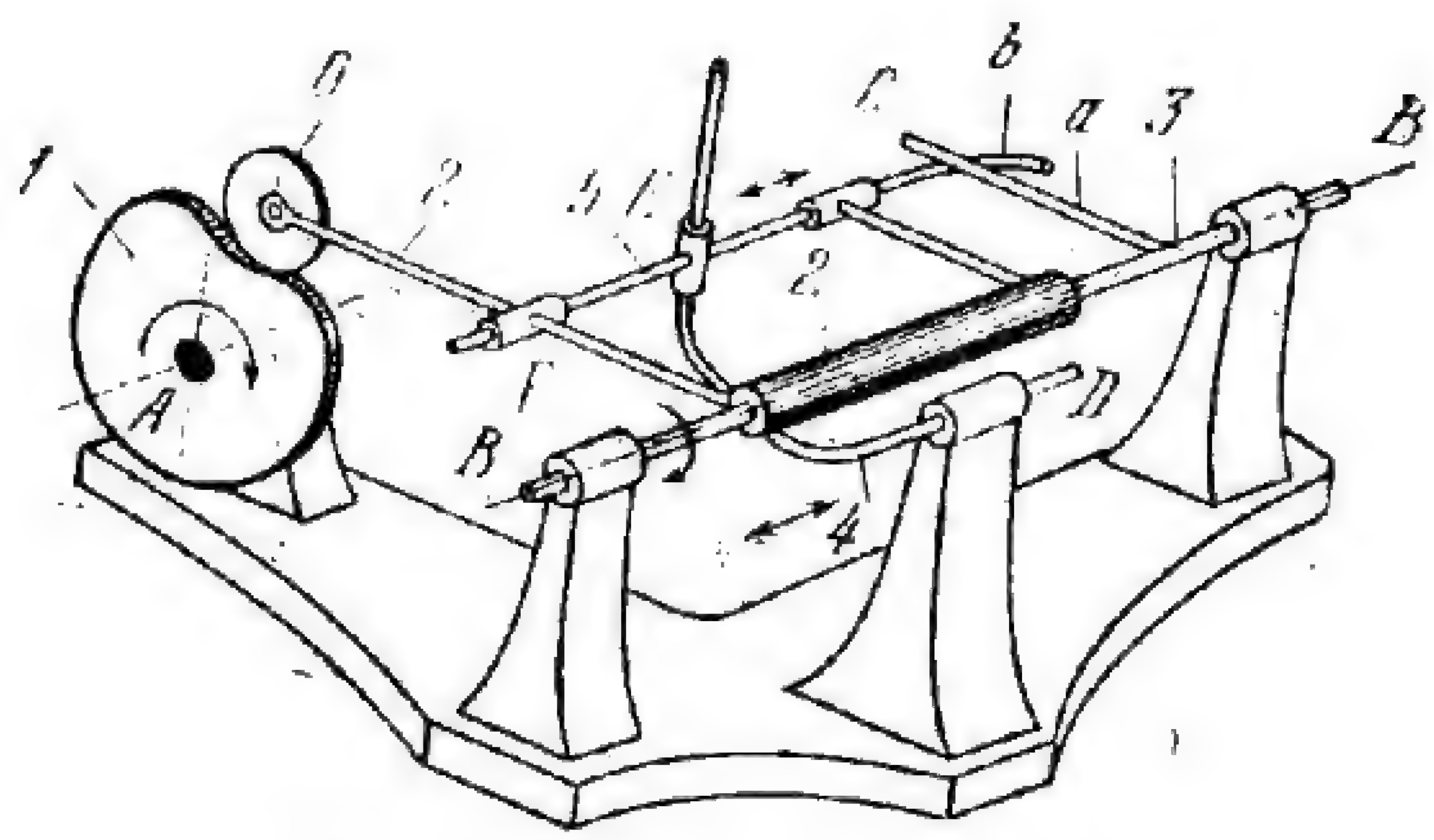
3177	CAM-LEVER CHAIN LINK FEEDING MECHANISM	CmL ML



3177	CAM-LEVER CHAIN LINK FEEDING MECHANISM	CmL ML

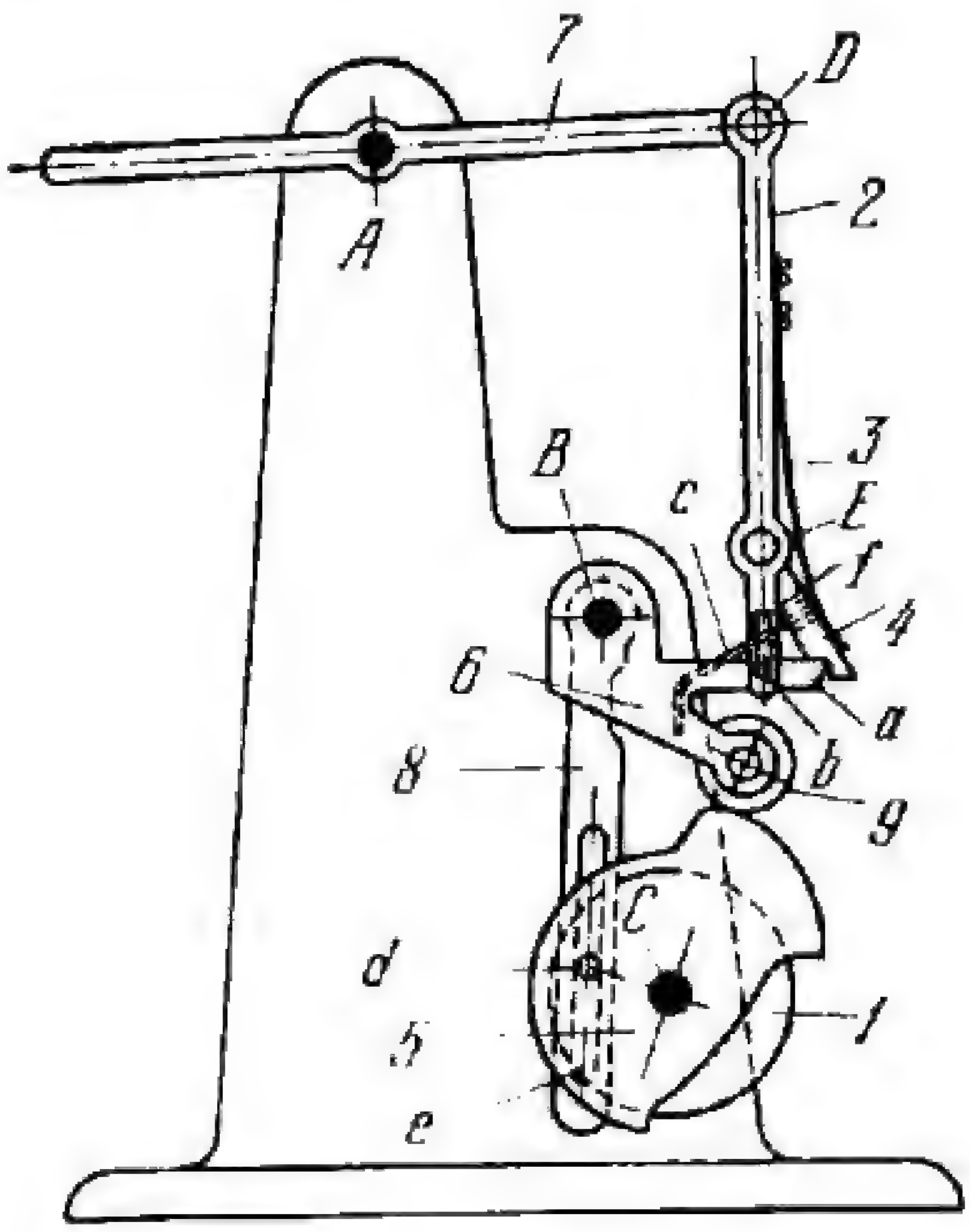
When shaft *17* rotates counterclockwise about fixed axis *A*, slide *1* reciprocates and plunger *2* feeds separate chain links *3* from magazine *4*. This motion is derived from face cam *5* and levers *6* and *7*. The feeding of the definite number of chain links required is obtained by adjusting dogs *a* on disk *8*. When disk *8* rotates, lever *9* is turned and latch *10* periodically locks slide *1* by acting on member *11*. When switching cam *12*, keyed to shaft *17*, rotates, it rotates gear *13* counterclockwise about fixed axis *B*. At this, right-hand dog *d* engages rack *14*, shifting it to the left. This turns pinion *15* clockwise, switching the thread ridges to the position shown by dash lines. By the action of a spring, bolt *16* locks gear *15* in this position. After this, gear *13* begins to rotate clockwise and continues until left-hand dog *d* switches the thread ridges back to their former position. Thus disk *8*, keyed to shaft *18* together with gear *13*, is turned periodically through the required angle. This angle is varied by adjusting dogs *d* on gear *13*.

3178	CAM-LEVER SPATIAL CROSSED-LEVERS MECHANISM	CmL ML



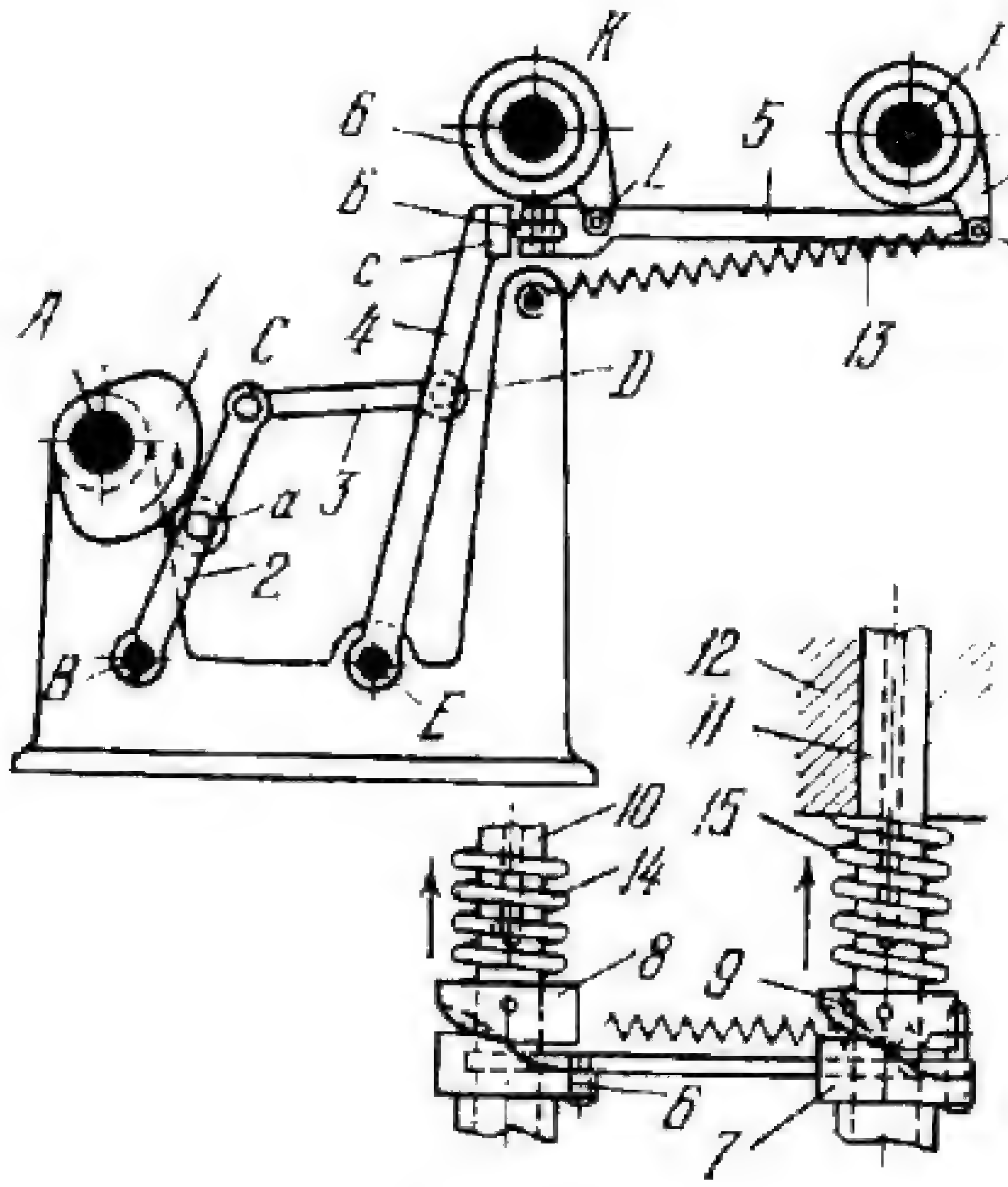
Cam *1* rotates about fixed axis *A*. Follower *2* oscillates about fixed axis *B-B* and carries roller *6* which rolls along the contour of cam *1*. Follower *2* is connected by cylindrical (turning and sliding) pairs *C* and *F* to link *5* which ends in lever *b*. Link *4* is connected by cylindrical pairs *D* and *E* to the base and to link *5*. Link *3* rotates freely about axis *B-B* and has lever *a* which slides along lever *b* of link *5*. When cam *1* rotates, link *5* has a complex motion consisting of oscillation with follower *2* about axis *B-B* and axial sliding due to the reciprocating motion of link *4* along the axis of cylindrical pair *D*. Link *4* is reciprocated by a separate mechanism (not shown). By means of crossed levers *b* and *a*, oscillation is transmitted to link *3*.

3179	**CAM-LEVER MECHANISM WITH FREE MOTION OF THE DRIVEN LINK**	CmL ML



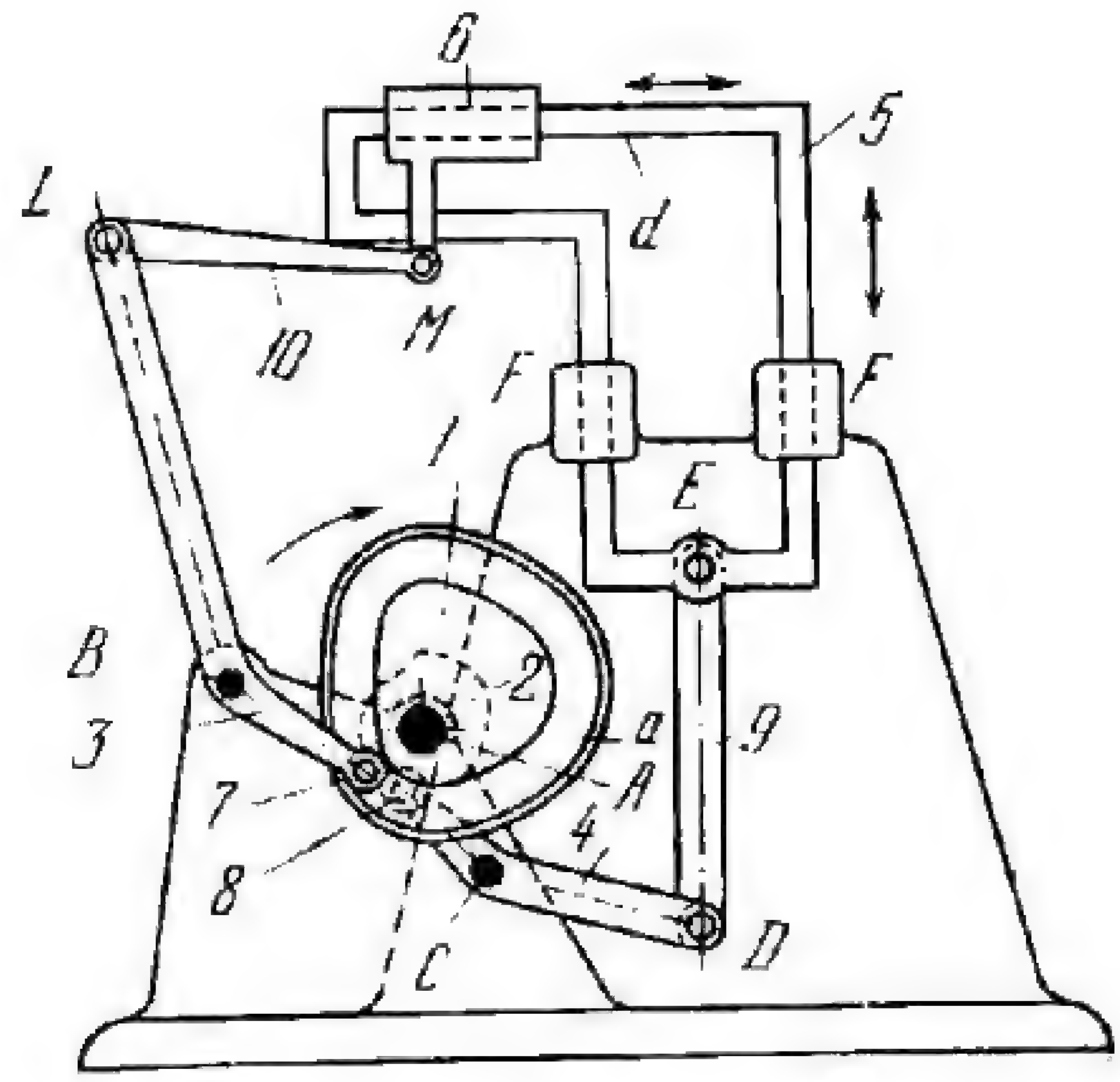
Rigidly attached cam *5* and disk *1* rotate about fixed axis *C*. Follower *6* oscillates about fixed axis *B* and carries roller *9* which rolls along the contour of cam *5*. Pin *d* of disk *1* slides along slot *e* in lever *8* which oscillates about axis *B*. Follower *6* has projection *a* with pin *b* which slides along slot *f* of intermediate link *2*. Link *2* is connected by turning pair *D* to link (secondary follower) *7* which oscillates about fixed axis *A*. Pawl *4* turns about axis *E* of link *2* and is held in engagement with projection *a* of follower *6* by flat spring *3*. Pawl *4* has thrust pin *c*. When cam *5* rotates, follower *6*, together with roller *9* and projection *a*, turns about axis *B*. Through pawl *4*, projection *a* lifts link *2*, turning link *7* about axis *A*. Link *7* remains in this position until slotted lever *8*, turned about axis *B* by pin *d* of disk *1*, pushes thrust pin *c* and disengages pawl *4* from projection *a*. At this, link *7* has a small free motion within the limits allowed by slot *f* which slides along pin *b* of follower *6*.

3180	CAM-LEVER SPATIAL MECHANISM WITH TWO DRIVEN LINKS	CmL ML



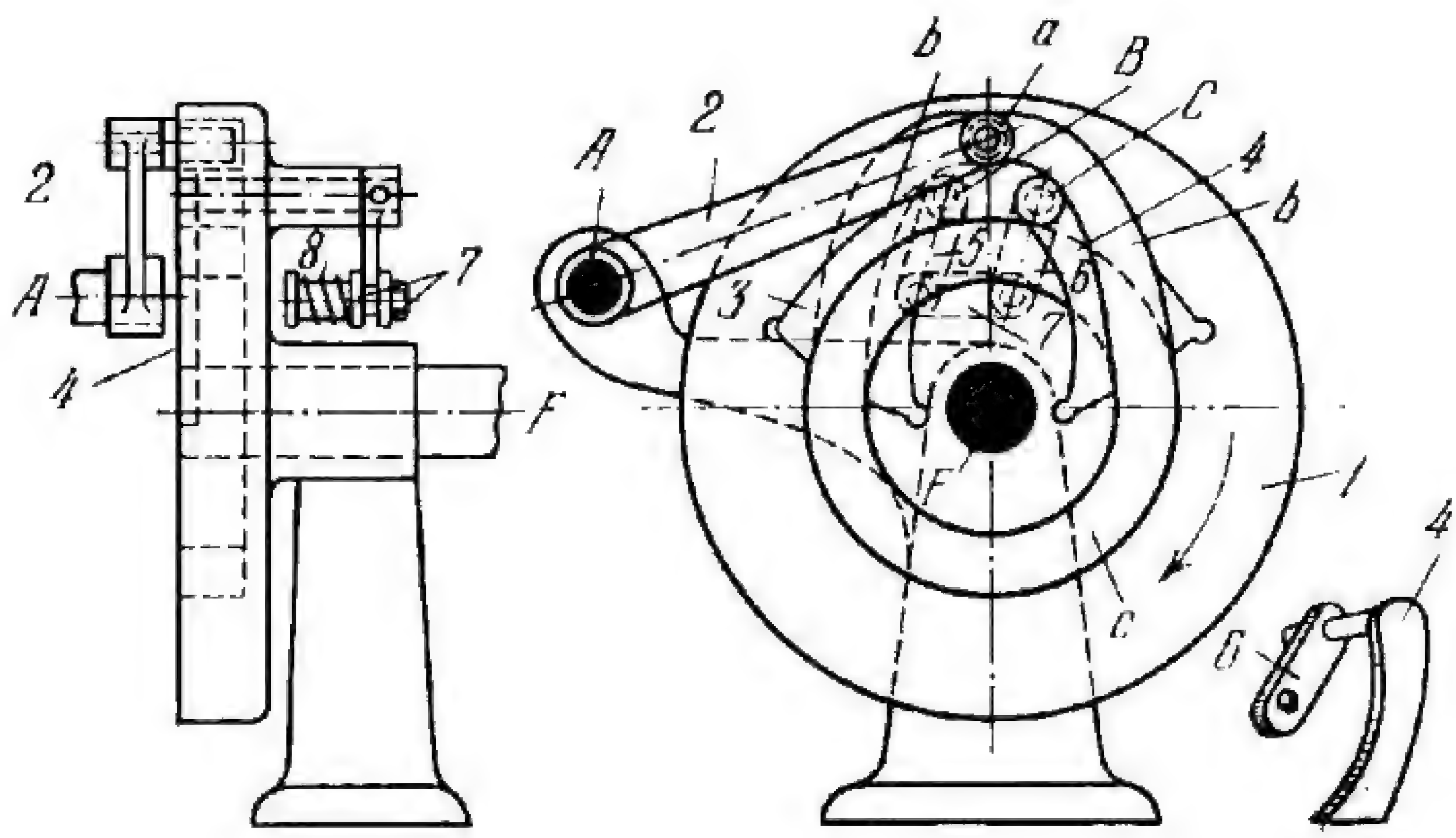
Cam *1* rotates about fixed axis *A*. Follower *2* oscillates about fixed axis *B* and carries roller *a* which rolls along the working surface of cam *1*. Link *3* is connected by turning pairs *C* and *D* to follower *2* and secondary follower *4* which oscillates about fixed axis *E*. Link *5* is connected by turning pairs *L* and *N* to side cams *6* and *7* which turn about fixed axes *K* and *F*. The lengths of the links comply with the conditions: $\overline{KL} = \overline{FN}$ and $\overline{KF} = \overline{LN}$; figure *KLNF* is a parallelogram. When cam *1* rotates, motion is transmitted from roller *a* through links *3* and *4* to link *5*. Attached to one end of link *5* is spring *13*, and roller *b* rotates freely at the other end, rolling along flat surface *c* of link *4*. Links *6* and *8*, and *7* and *9* are mating side cams. As they turn with respect to each other, the cam surfaces slide along the mating surfaces, displacing bars *10* and *11* in fixed guides of base *12*. When follower *2* is deflected the maximum amount to the right, bars *10* and *11* are displaced the maximum distance in the direction of the arrows. Springs *14* and *15* return bars *10* and *11* to their initial positions.

3181	CAM-LEVER MECHANISM WITH COMPLEX TRANSLATIONAL MOTION OF THE DRIVEN LINK	CmL ML



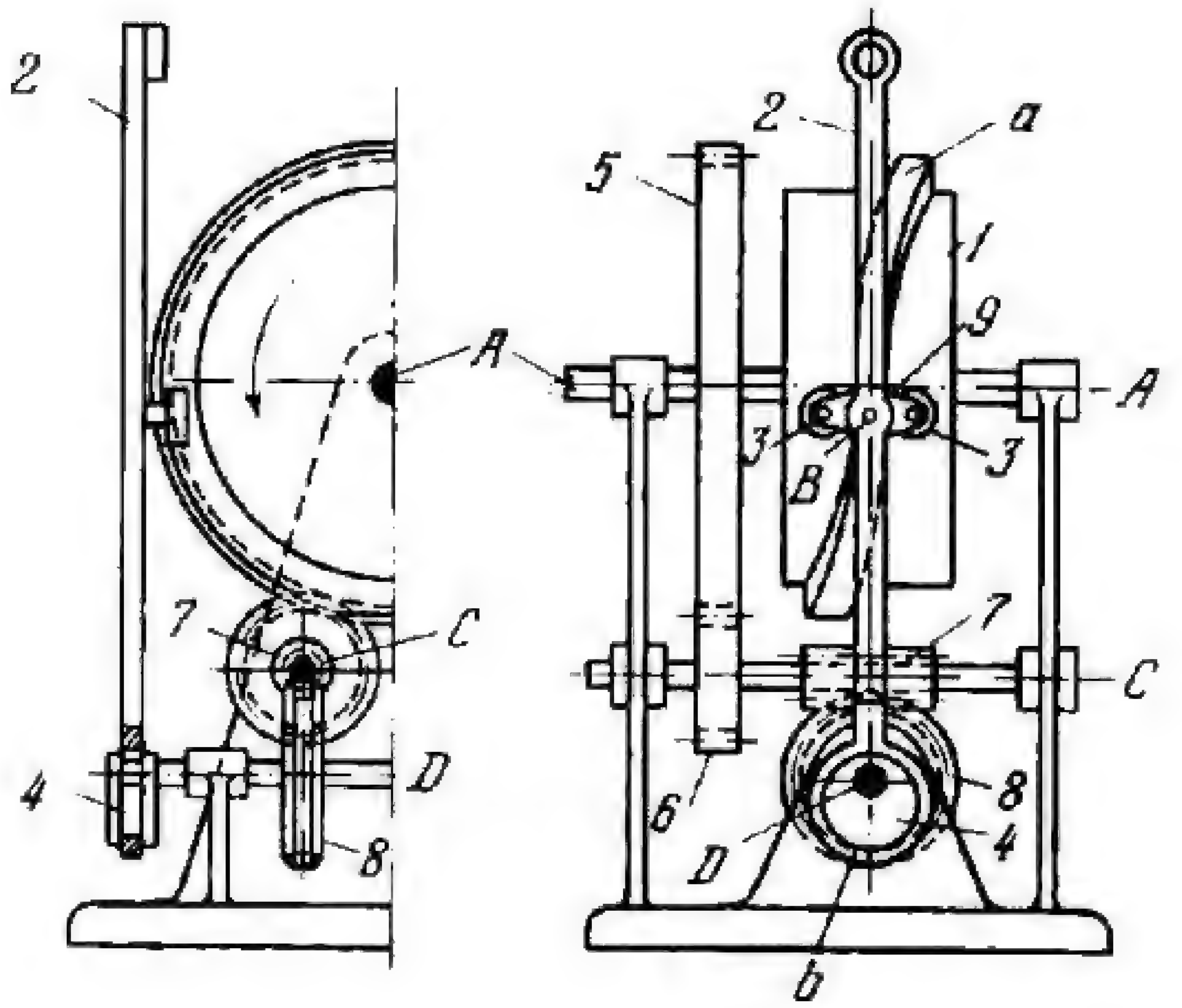
Rigidly attached cams *1* and *2* rotate about fixed axis *A*. Face cam *1* has profiled groove *a*. Follower *3* oscillates about fixed axis *B* and carries roller *7* which rolls and slides along groove *a*. Follower *4* oscillates about fixed axis *C* and carries roller *8* which rolls along the working surface of cam *2*. Link *9* is connected by turning pairs *D* and *E* to follower *4* and to link *5* which reciprocates in fixed guides *F-F*. Link *10* is connected by turning pairs *L* and *M* to follower *3* and to slider *6* which moves along guide *d* of link *5*. When cams *1* and *2* rotate, slider *6* has a complex translational motion with respect to the base. Any complex translational motion of slider *6* can be obtained by suitably designing the working surfaces of cams *1* and *2*.

3182	CROSSED-GROOVE FACE CAM-LEVER MECHANISM	CmL ML



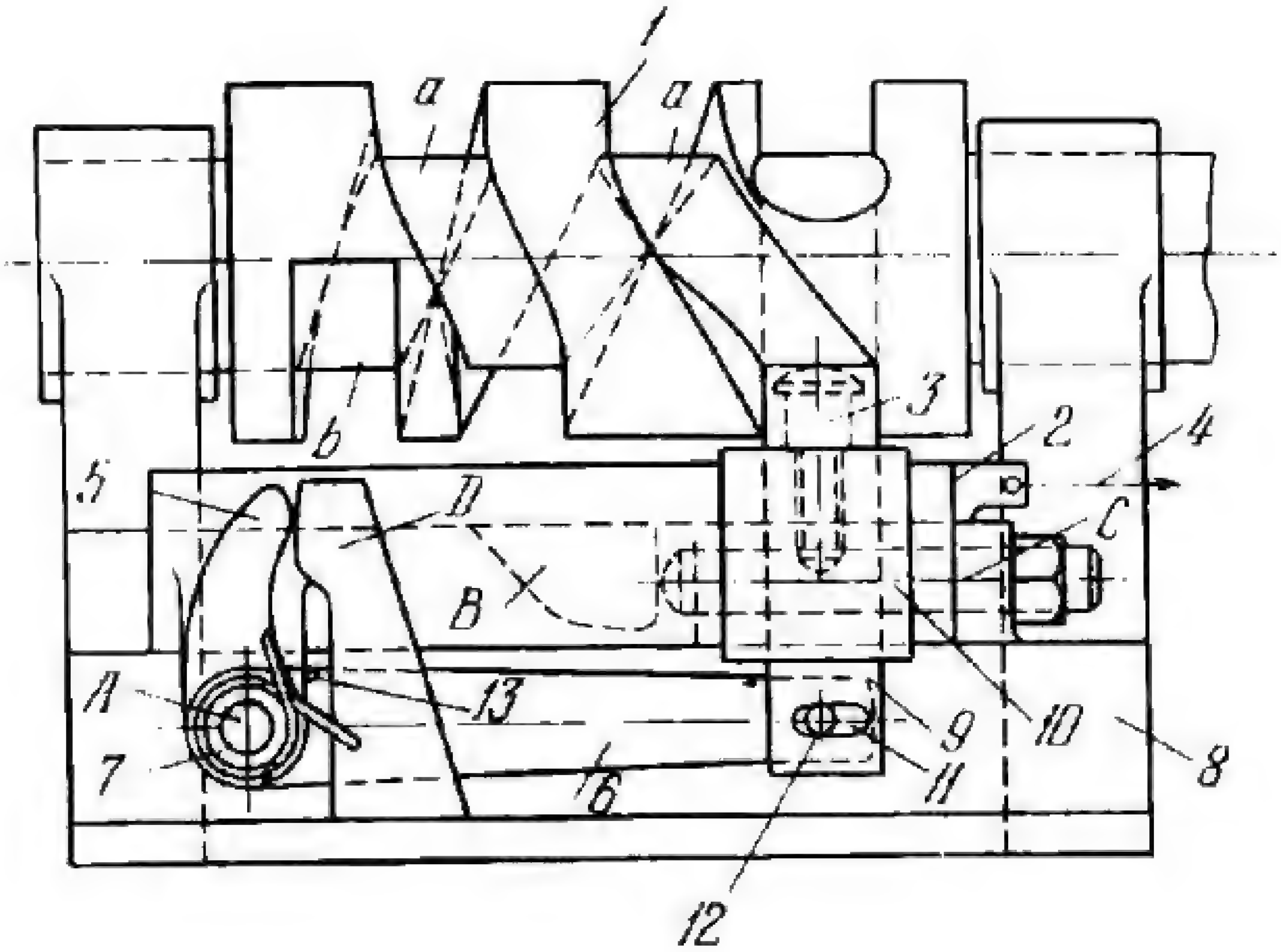
When face cam 1 rotates clockwise about fixed axis F, roller a of follower 2 passes along portion b of the cam groove, running up against latch 3 and turning it to the right. Latch 3 is rigidly attached to link 5 of a parallel-crank linkage consisting of links 5, 6 and 7. Axes B and C of links 5 and 6 are in cam 1. Latch 4 is rigidly attached to link 6. When latch 3 is turned counterclockwise by roller a, latch 4 turns in the same direction, permitting roller a to enter the upper portion of concentric groove c. As cam 1 continues to rotate, roller a again turns latch 3, returning it clockwise to the position shown, so that in the next revolution of cam 1, roller a passes from concentric groove c to portion b. While roller a is in portion b, follower 2 has an oscillating motion about fixed axis A. To two revolutions of cam 1, follower 2 swings once in each direction. Unintentional motion of latches 3 and 4 due to gravity is excluded because link 7 consists of two strips, one on each side of links 5 and 6. Springs 8 hold the strips against links 5 and 6, creating a friction drag that prevents unintentional motion of the latches.

3183	SPATIAL CAM-LEVER MECHANISM WITH COMPLEX DRIVEN LINK MOTION	CmL ML



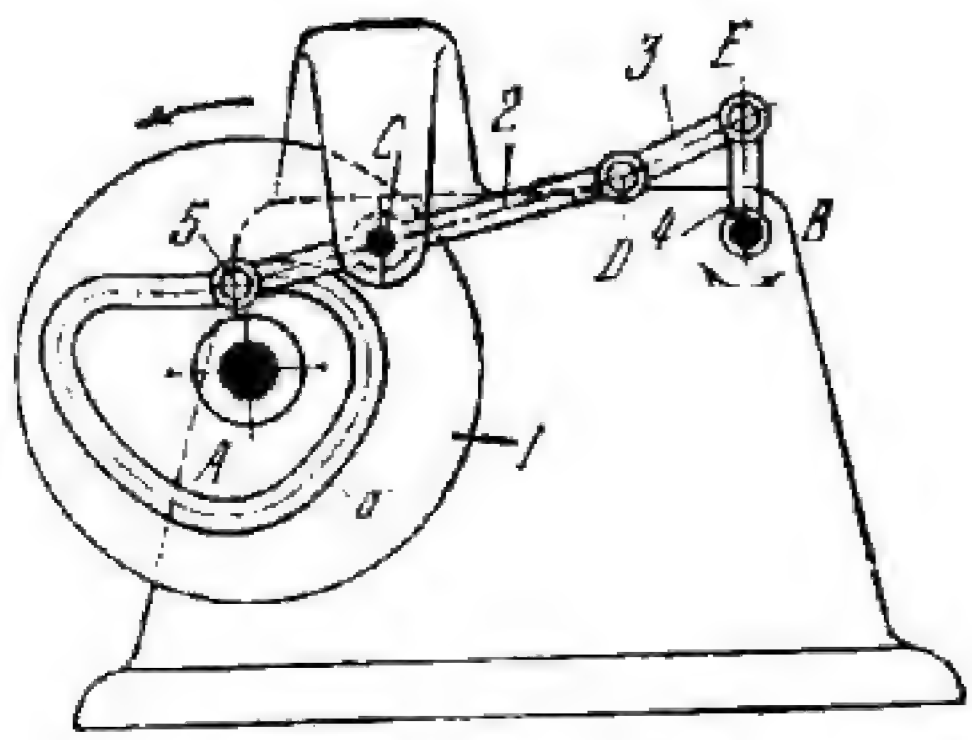
Cylindrical ridge cam *1* rotates about fixed axis *A* and has profiled ridge *a*. Follower *2* is connected by turning pair *B* to crosspiece *9* which carries two rollers *3*, rolling along the side surfaces of ridge *a*. The lower end of follower *2* is collar *b* which encircles round eccentric *4*. Eccentric *4* rotates about fixed axis *D* and is rigidly attached to worm wheel *8* which meshes with worm *7*. Gear *5*, rigidly attached to cam *1*, meshes with gear *6* which is rigidly attached to worm *7* and rotates with it about fixed axis *C*. When cam *1* rotates, follower *2* has a complex motion.

3184	LONG-STROKE RAPID-RETURN SPATIAL CAM-LEVER MECHANISM	CmL ML



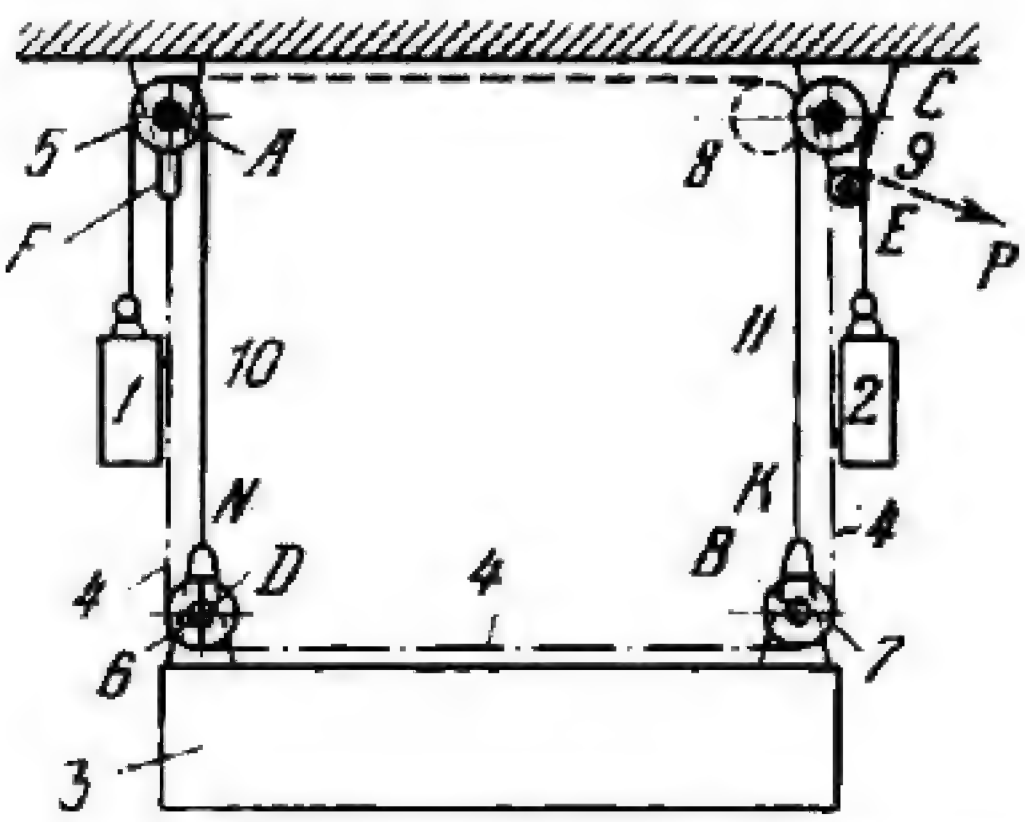
Cylinder cam *1* has continuous groove *a-a* of which, in end portion *b*, the bottom of the groove slopes gradually toward the outside of the cam. Slide *2* reciprocates in fixed guides of base *8*. Roller *3* is mounted on plunger *9* which can slide in guide *10*. Guide *10* is integral with slide *2*. Levers *5* and *6* turn about axis *A* of slide *2* and are connected together by coil spring *7* which holds lever *5* against pin *13* in lever *6*. Pin *12* in lever *6* slides along slot *11* in plunger *9*. When cam *1* rotates counterclockwise (looking from the right), slide *2* is traversed by roller *3* to the left until the roller reaches portion *b* of groove *a-a* and is forced out of the groove, pushing back plunger *9*. As soon as the roller is disengaged from cam *1*, slide *2* is rapidly returned to its right-hand position by a counterweight (not shown) on cable *4*. This motion is limited by stop *B* on slide *2* and adjusting screw *C* in base *8*. Just before slide *2* reaches its extreme right-hand position, lever *5* comes into contact with stop *D* on the base, swinging lever *6* upward and forcing roller *3* into the groove of cam *1* by the action of spring *7*.

3185	**CAM-LEVER MECHANISM WITH A LARGE AMPLITUDE OF DRIVEN LINK OSCILLATION**	**CmL ML**



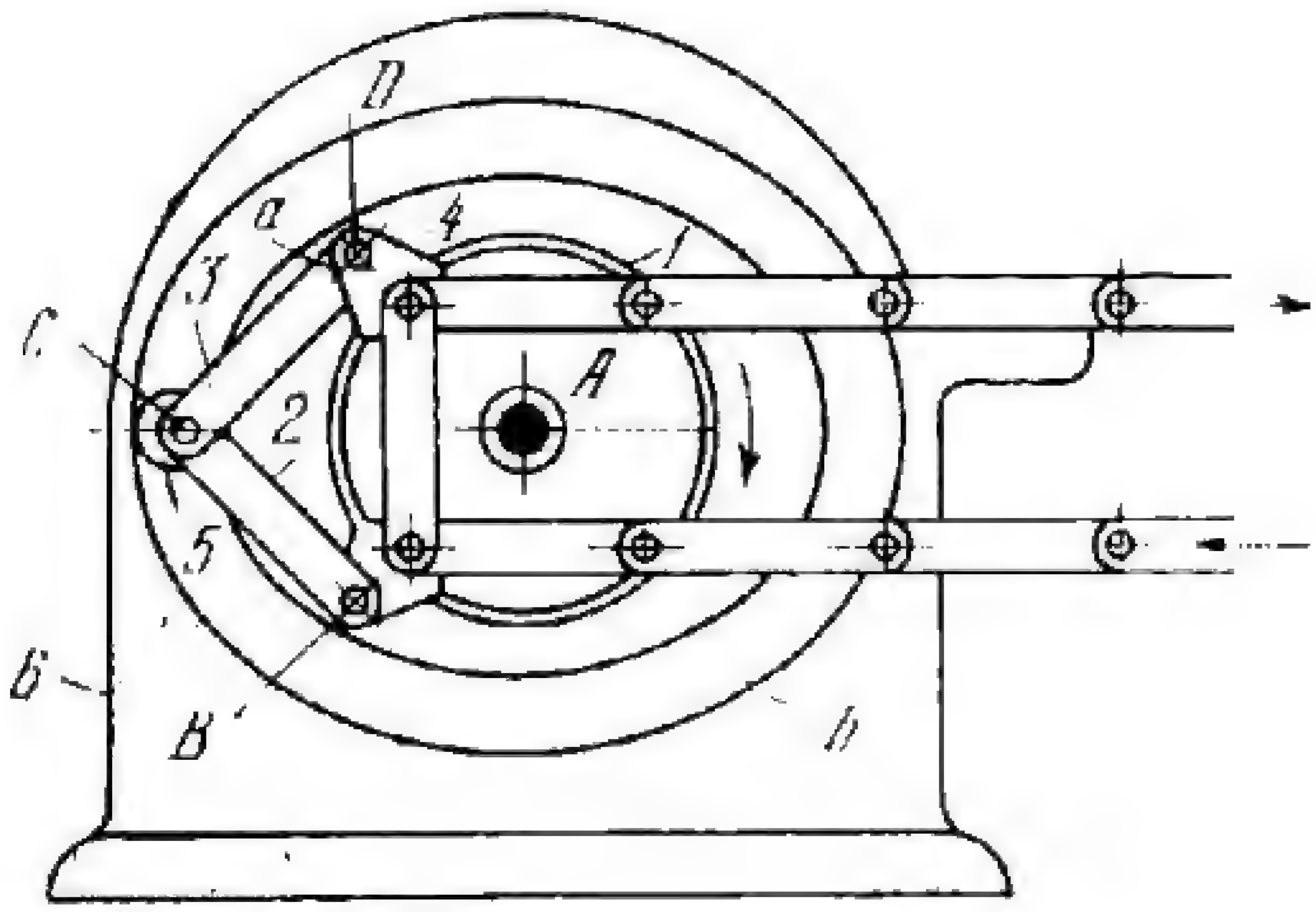
Face cam *1* rotates about fixed axis *A* and has profiled groove *a*. Follower *2* oscillates about fixed axis *C* and carries roller *5* which rolls and slides along groove *a*. Intermediate link *3* is connected by turning pairs *D* and *E* to follower *2* and to secondary follower *4* which oscillates about fixed axis *B*. The lengths of the links are designed so that the amplitude of the oscillation of secondary follower *4* is much greater than that of follower *2*.

3186	**PLATFORM HOISTING MECHANISM**	**CmL ML**



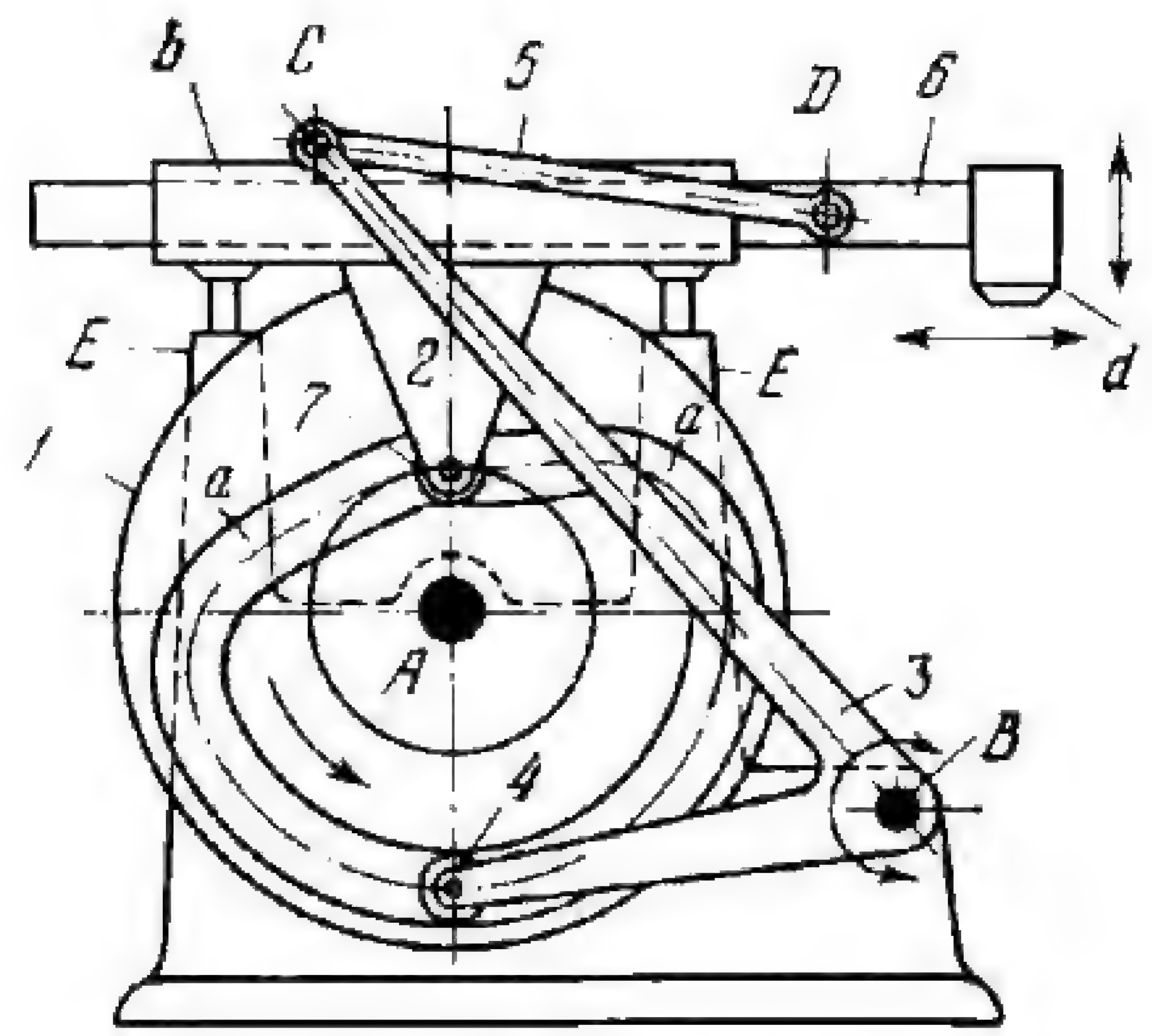
Sheaves *6* and *7*, of equal diameter, rotate about axes *D* and *B* of platform *3* which is being hoisted. Flexible link *4*, shown by dot-and-dash lines, is secured to the fixed member at point *F* and runs over sheaves *6*, *7* and *9*. Sheave *9* rotates about fixed axis *E*. Flexible links *10* and *11* are connected to platform *3* at points *N* and *K*, and run over sheaves *5* and *8*, of equal diameter, which rotate about fixed axes *A* and *C*. Equal weights *1* and *2*, serving as counterweights, are secured to the other ends of flexible links *10* and *11*. To hoist platform *3*, a force *P* is applied to flexible link *4*. The platform has straight translational motion along a vertical axis.

3187	CAM-LEVER CHAIN DRIVE MECHANISM WITH A CORRECTING GROOVE	CmL ML



In order to obtain uniform motion of a conveyer chain with constant velocity, a definite kind of motion must be imparted to chain sprocket *4*. This is accomplished by connecting the sprocket to driving disk *1* through links *2* and *3* which converge or diverge in accordance with the position of roller *5* in correcting groove *b*. As a result, sprocket *4* either lags behind the rotation of disk *1* or leads, with two gradually changing lead and lag phases to each revolution of disk *1*. Disk *1* rotates at constant angular velocity about fixed axis *A* and is connected by turning pair *B* to link *2*. Link *3* is connected by turning pairs *C* and *D* to link *2* and to lug *a* of chain sprocket *4* which is square in shape. Roller *5* rotates freely about axis *C* and rolls and slides along fixed groove *b*.

3188	CAM-LEVER MECHANISM FOR MOTION IN TWO PERPENDICULAR DIRECTIONS	CmL ML



Face cam *1* rotates about fixed axis *A* and has profiled groove *a*. Follower *3* oscillates about fixed axis *B* and carries roller *4* which rolls and slides along groove *a*. Connecting rod *5* is connected by turning pairs *C* and *D* to follower *3* and to slide *6* which reciprocates in guide *b* of follower *2*. Follower *2* reciprocates in fixed guides *E-E* and carries roller *7* which rolls and slides along groove *a*. Groove *a* is designed so that slide *6* with member *d* reciprocates in two perpendicular directions. During horizontal travel of slide *6*, follower *2* is stationary. On the other hand, during vertical travel of slide *6*, together with follower *2*, slide *6* has no horizontal motion in guide *b*.

3189	CAM-LEVER MECHANISM WITH A KNIFE-EDGE FOLLOWER	CmL ML

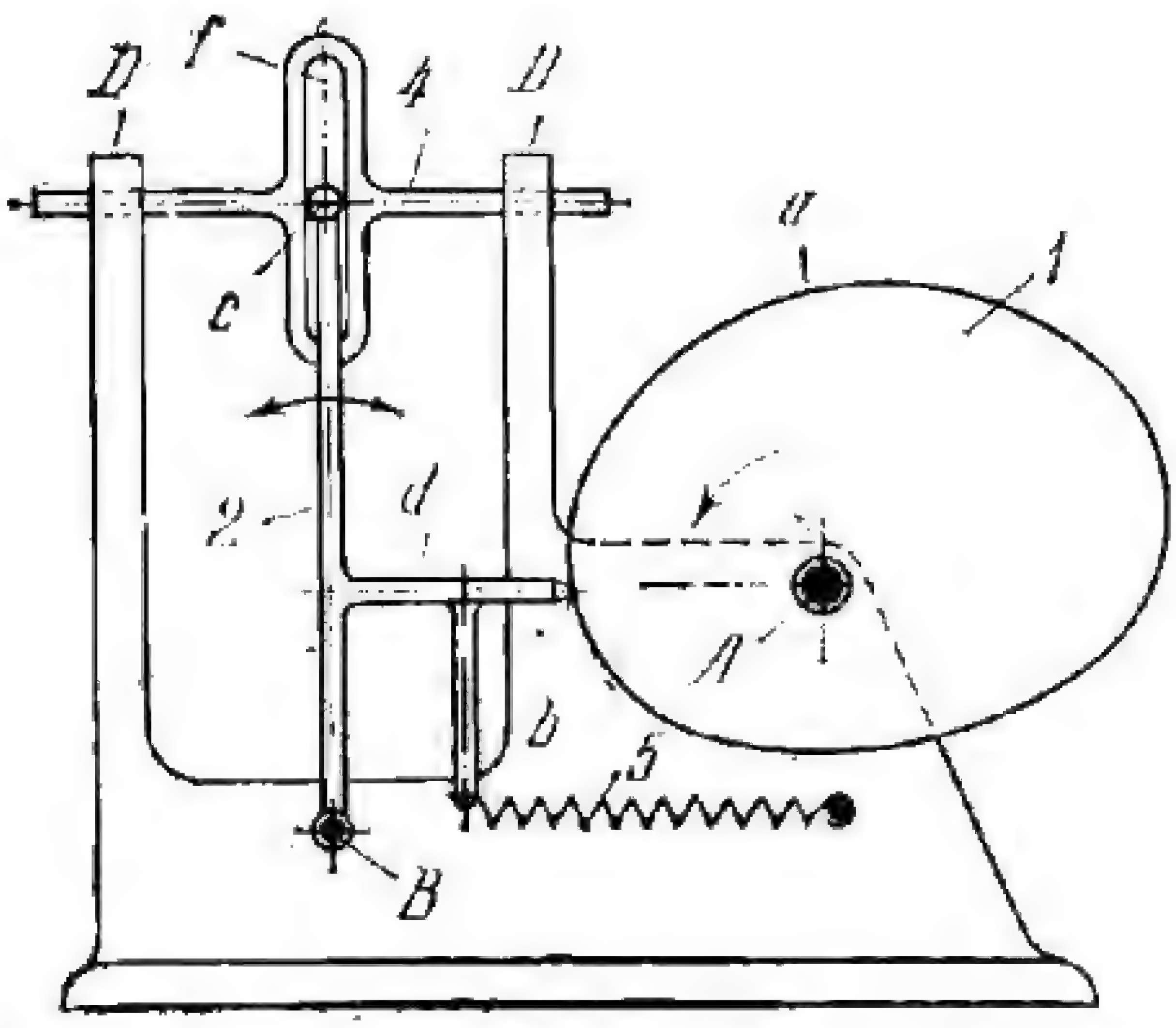


Plate cam *1* rotates about fixed axis *A*. Follower *2* oscillates about fixed axis *B* and has pin *d* with knife-edge *b* which slides along contour *a* of cam *1*. Pin *c* of follower *2* slides along slot *f* of slide *4* which reciprocates in fixed guides *D-D*. Knife-edge *b* is held in contact with cam *1* by spring *5*.

3190	CAM-LEVER MECHANISM WITH A SECONDARY FOLLOWER	CmL ML

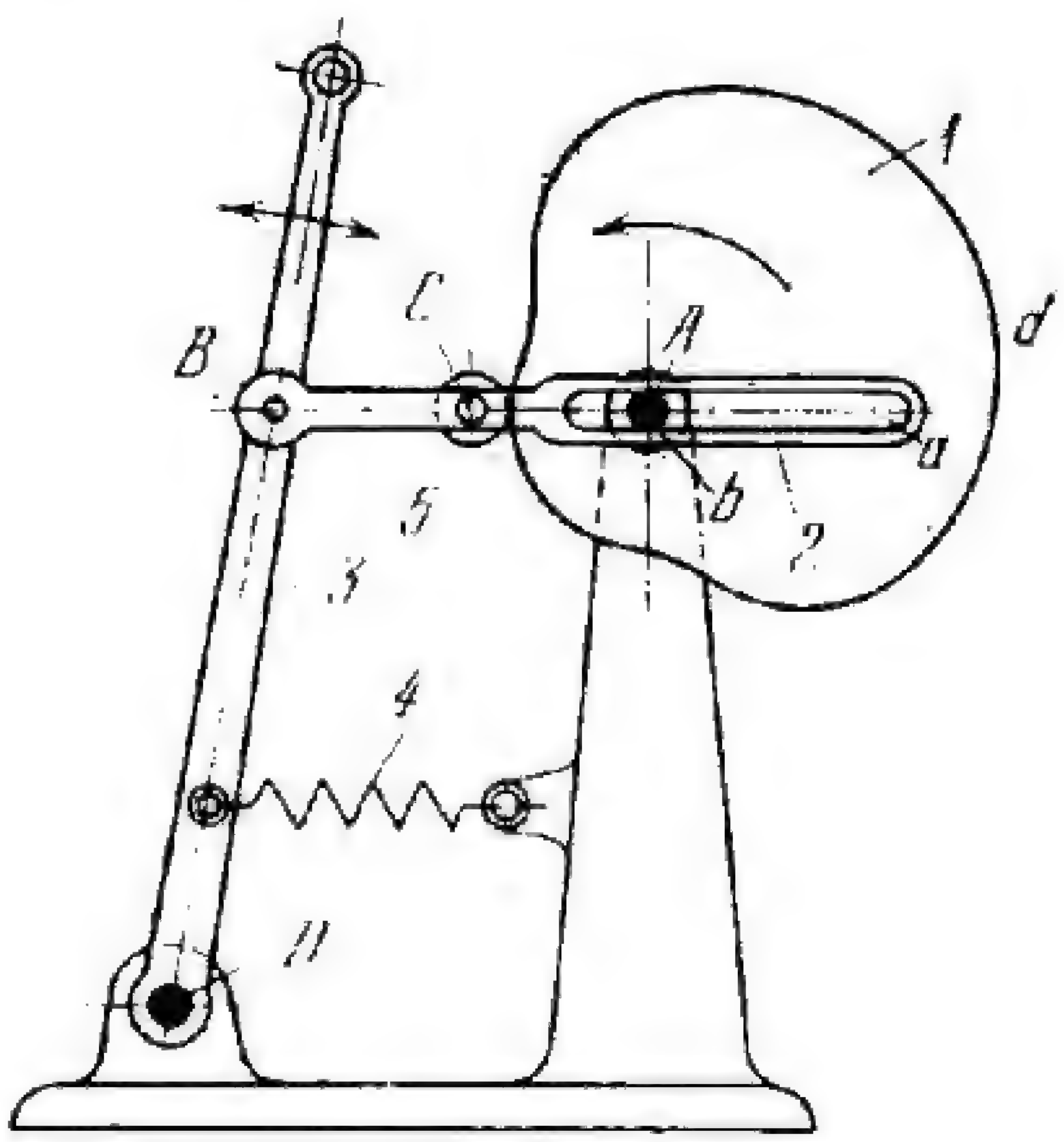
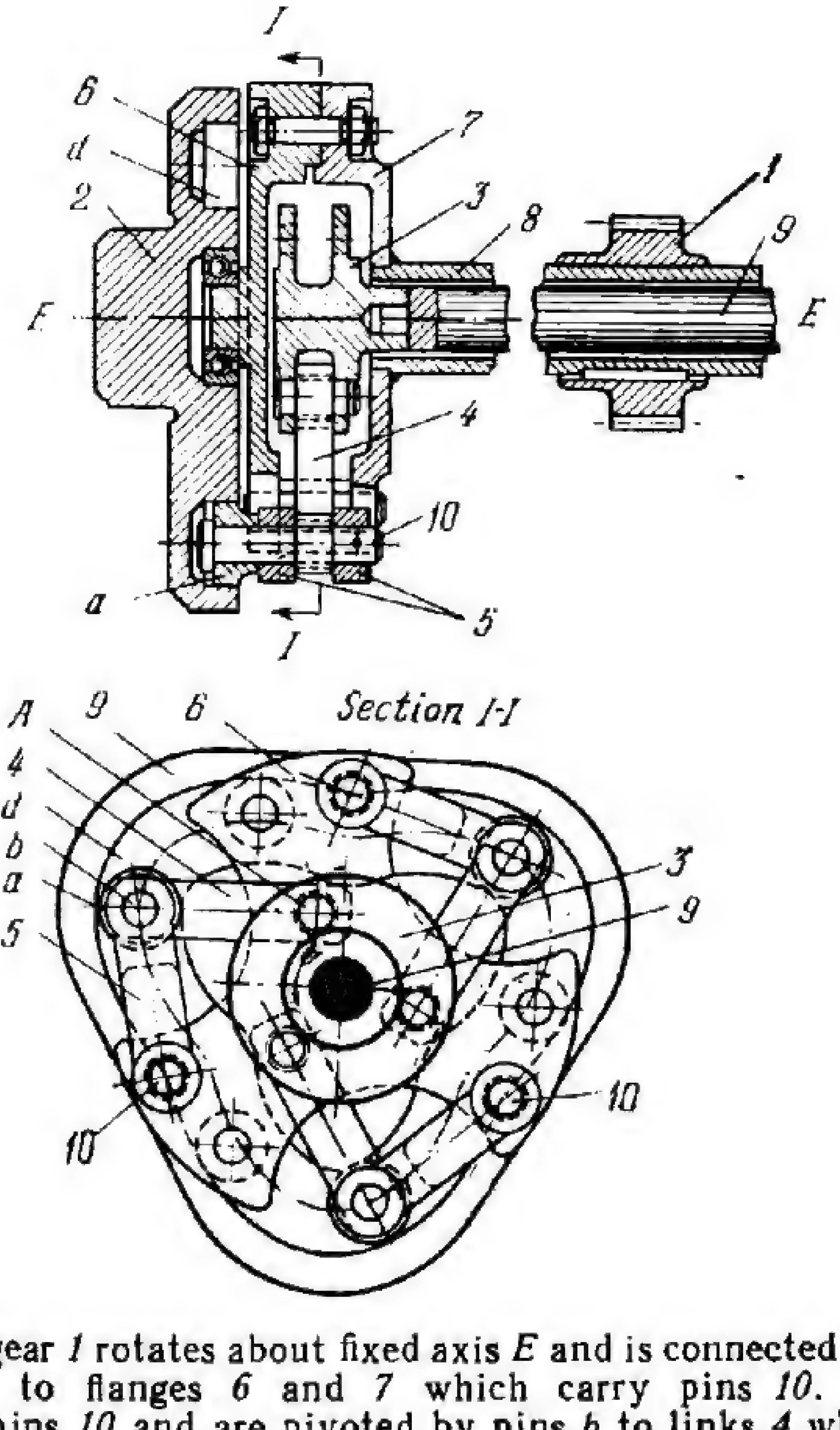


Plate cam *1* rotates about fixed axis *A*. Follower *2* slides with its slot *a* along fixed pin *b* and carries roller *5* which rotates freely about axis *C* and rolls along contour *d* of cam *1*. Follower *2* is connected by turning pair *B* to secondary follower *3* which oscillates about fixed axis *D*. When cam *1* rotates, follower *2* has a complex motion and secondary follower *3* oscillates. Roller *5* is held in contact with cam *1* by spring *4*.

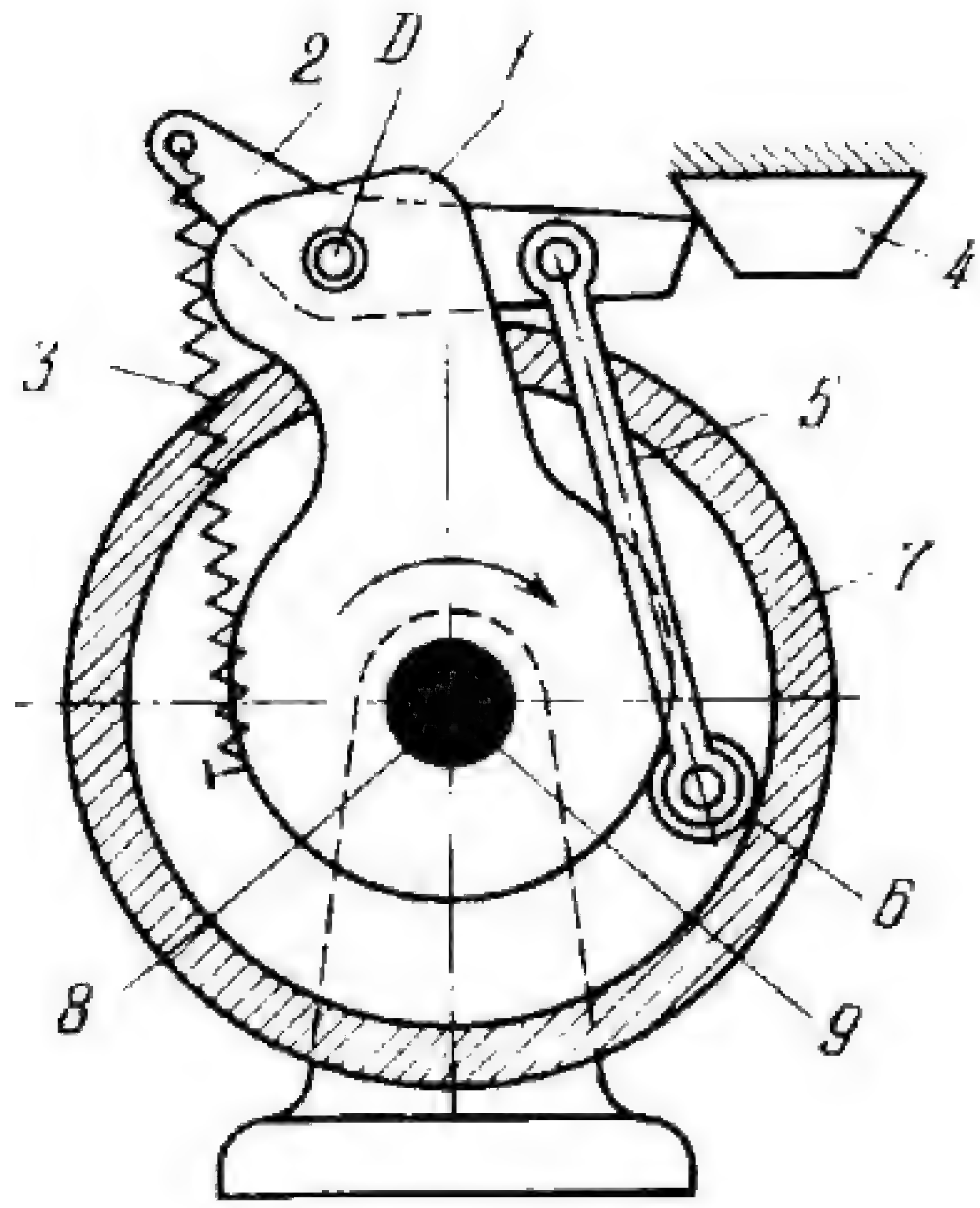
2. DWELL MECHANISMS (3191 through 3195)

3191	CAM-LEVER DWELL MECHANISM	CmL D



Driving gear *1* rotates about fixed axis *E* and is connected through sleeve *8* to flanges *6* and *7* which carry pins *10*. Links *5* turn on pins *10* and are pivoted by pins *b* to links *4* which, in turn, are pivoted to drive member *3* of driven shaft *9*. Rollers *a* rotate freely on pins *b* and roll and slide along groove *d* of fixed cam *2*. Portions of groove *d* are along circular arcs described from centres *A*, the axes of the pins connecting links *4* to drive member *3*. Thus, when gear *1* rotates continuously, driven shaft *9* rotates intermittently with dwells.

3192	CAM-LEVER DWELL MECHANISM	CmL D



Cam *1* is keyed to driven shaft *8* and is connected by turning pair *D* to bellcrank lever *2*, one arm of which is connected by spring *3* to cam *1*. The spring tends to turn lever *2* but this motion is prevented by fixed prismatic member *4*. Tie-rod *5* is pivoted to lever *2* and carries roller *6*. Drum *7* is keyed to driving shaft *9*. When lever *2* is released from the restraint of member *4*, it turns counterclockwise so that roller *6* is jammed between drum *7* and cam *1*, and the cam begins to rotate together with driven shaft *8*.

3193	CAM-LEVER INTERMITTENT MOTION MECHANISM	CmL D

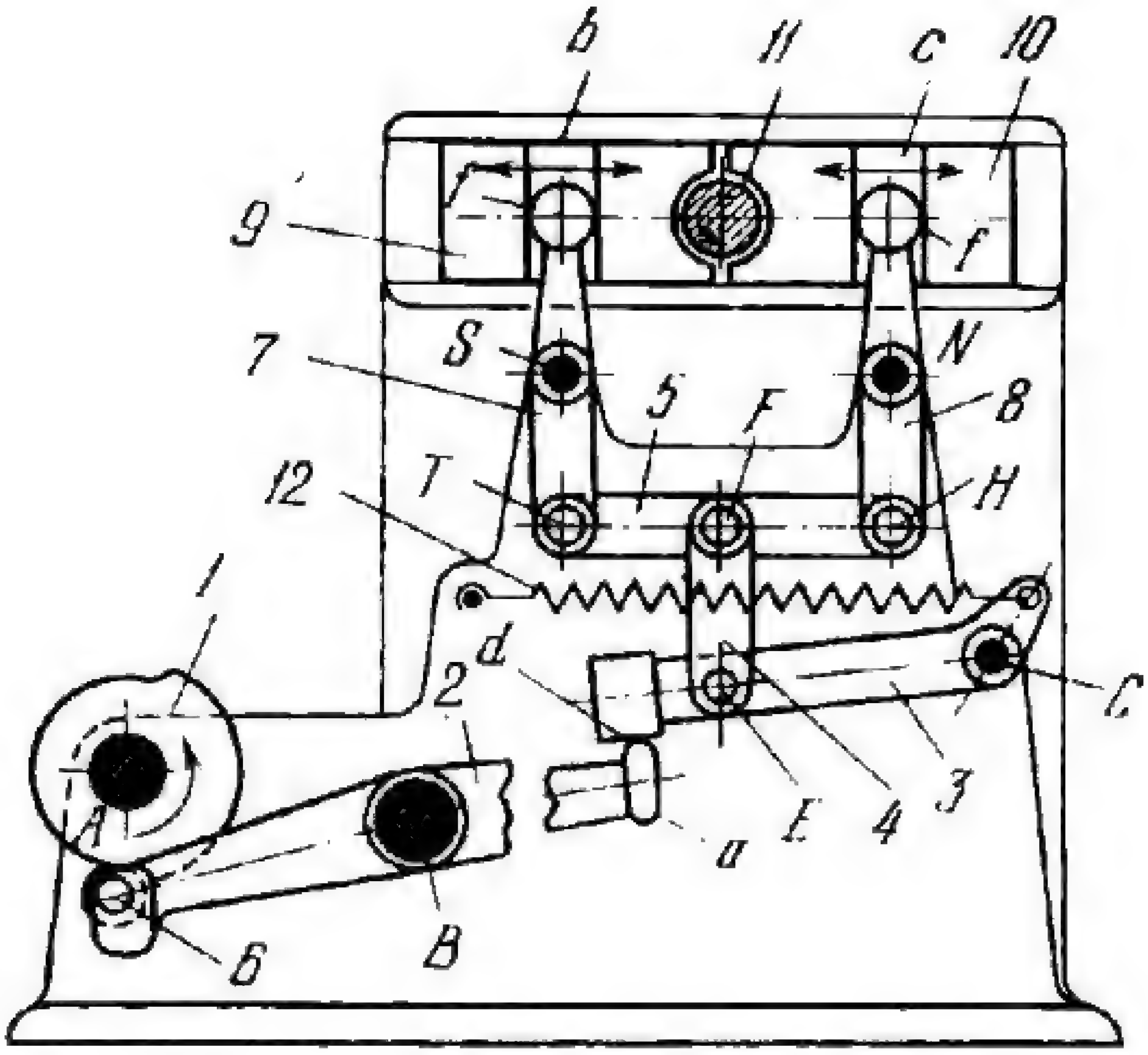
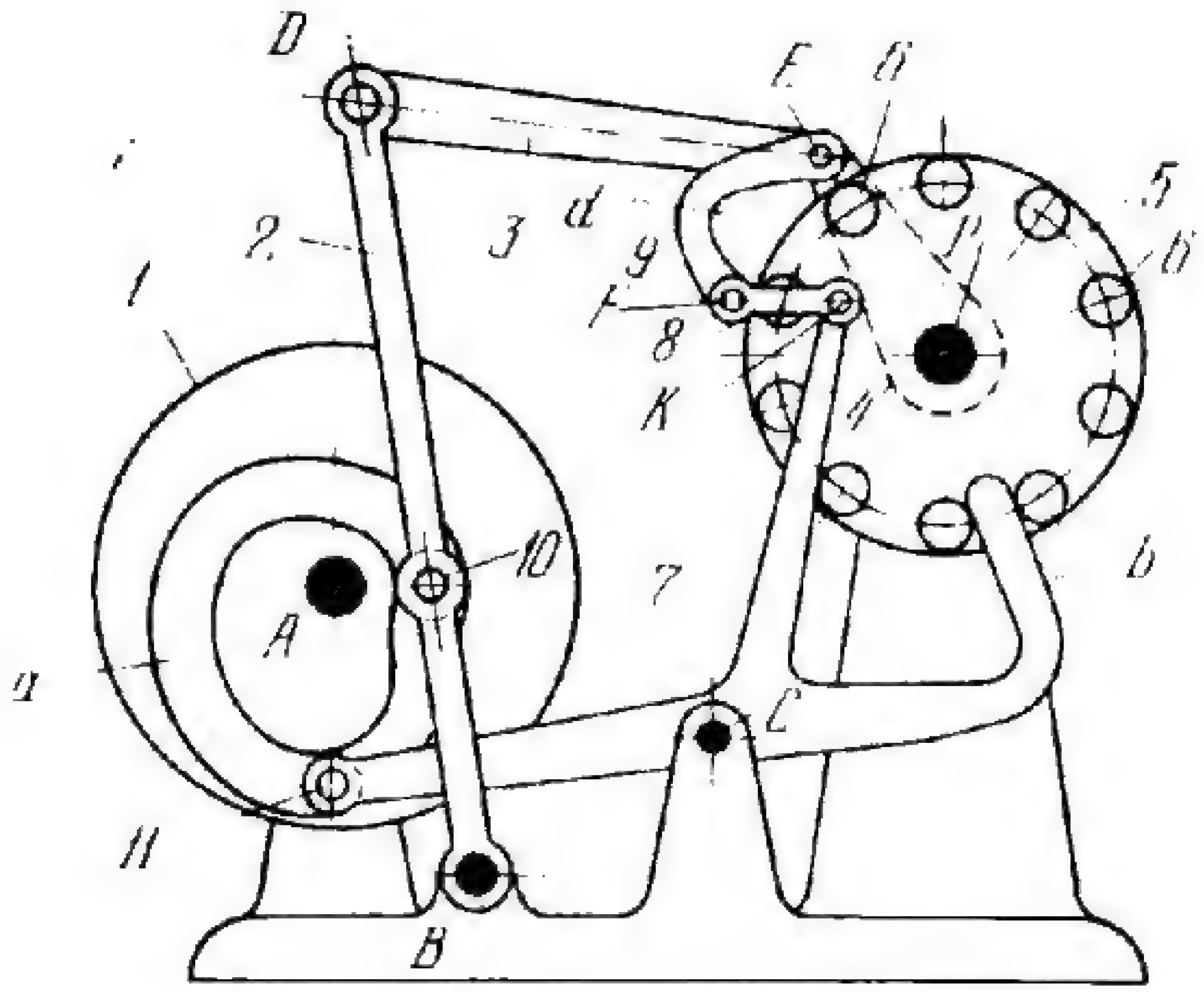


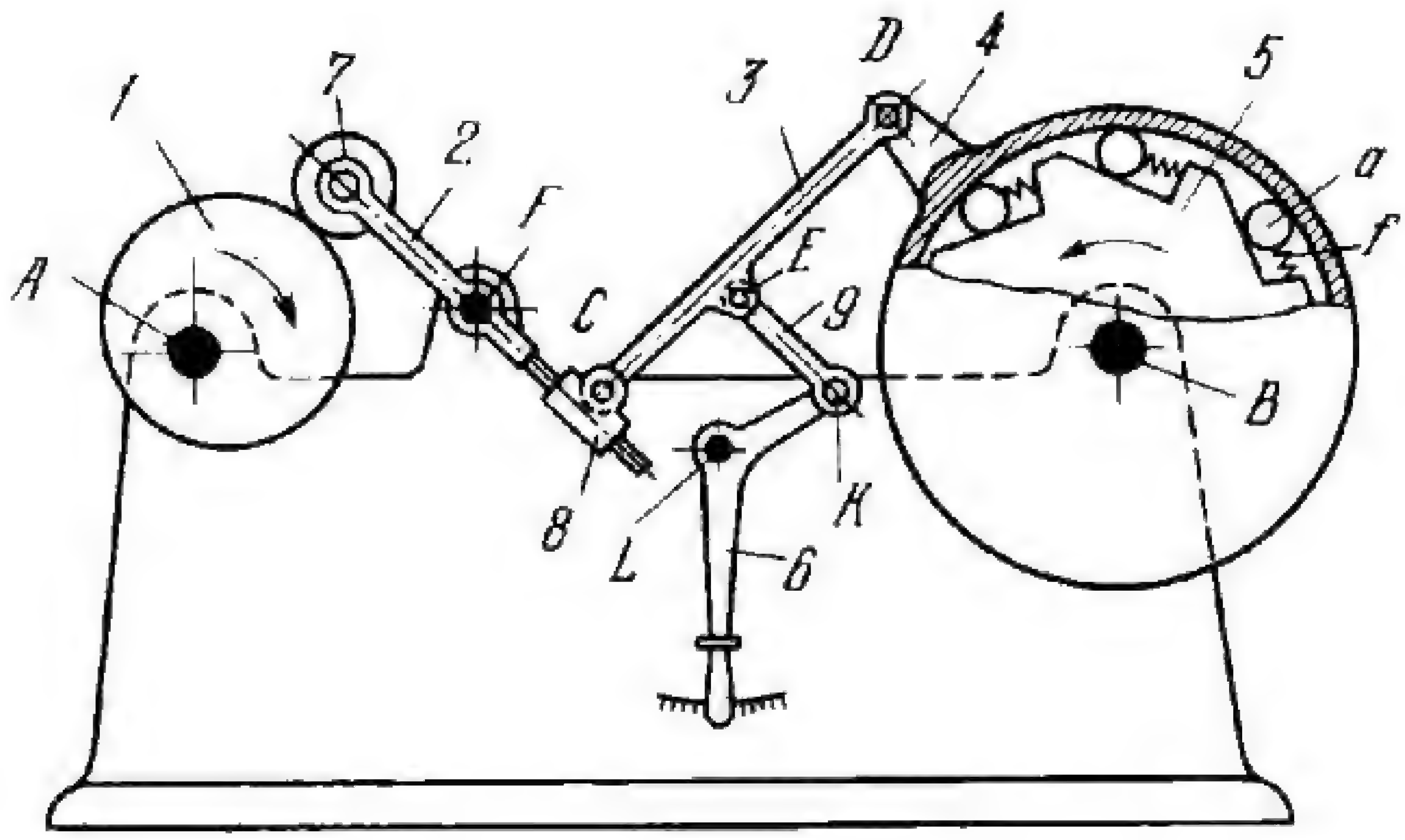
Plate cam *1* rotates about fixed axis *A*. Follower *2* oscillates about fixed axis *B* and carries roller *6* which rolls along the contour of cam *1*. Head *a*, at the other end of follower *2*, slides along flat surface *d* of link *3* which turns about fixed axis *C*. Link *4* is connected by turning pairs *E* and *F* to link *3* and to crosspiece *5* which, in turn, is connected by turning pairs *T* and *H* to links *7* and *8*. Links *7* and *8* turn about fixed axes *S* and *N* and have spherical surfaces *f* which slide in slots *b* and *c* of half-nuts *9* and *10*. This brings the half-nuts together or spreads them apart, engaging or disengaging rotating screw *11* which is either fed axially or has a dwell. When the half-nuts are closed, the screw is fed; when the half-nuts are open, axial motion of the screw stops. Roller *6* is held in contact with cam *1* by spring *12*. The lengths of the links comply with the conditions: $\overline{ST} = \overline{NH}$, $\overline{TF} = \overline{FH}$ and $\overline{TH} = \overline{SN}$.

3194	CAM-LEVER PIN-WHEEL DWELL MECHANISM	CmL D



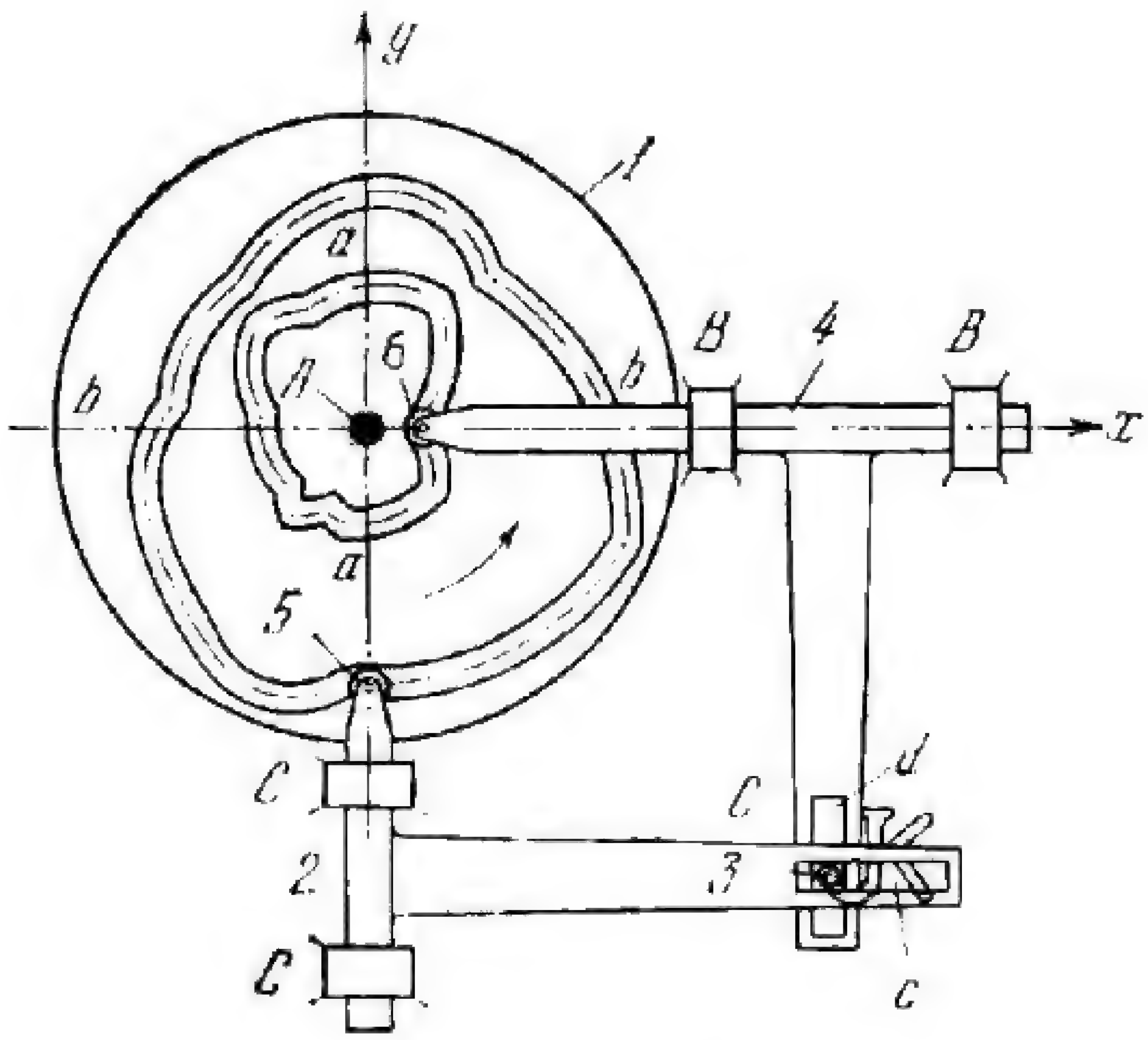
Face cam *1* rotates about fixed axis *A* and has profiled groove *a*. Followers *2* and *7* oscillate about fixed axes *B* and *C* and carry rollers *10* and *11* which roll and slide along groove *a*. Connecting rod *3* is connected by turning pairs *D* and *E* to follower *2* and to link *4* which turns about fixed axis *P*. Pin-wheel *5* is rotated about axis *P* by member *9* whose recess *d* successively engages pins *6* of wheel *5*. Member *9* is connected by turning pairs *E* and *F* to link *4* and to link *8* which, in turn, is connected by turning pair *K* to follower *7*. Follower *7* has lug *b* which periodically enters the space between two adjacent pins *6* of wheel *5* to prevent unintentional rotation of the pin-wheel during its dwell periods. When cam *1* rotates continuously, pin-wheel *5* rotates intermittently with dwells.

3195	CAM-LEVER VARIABLE INTERMITTENT ROTATION MECHANISM	CmL D



Round eccentric plate cam *1* rotates about fixed axis *A*. Follower *2* oscillates about fixed axis *F* and carries roller *7* which rolls along the contour of cam *1*. Link *3* is connected by turning pairs *C*, *E* and *D* to slider *8*, link *9* and to link *4* which oscillates about fixed axis *B*. Slider *8* moves along the axis of follower *2*. Link *9* turns about axis *K* whose location can be varied and locked in the required position by lever *6* which turns about fixed axis *L*. Arranged between link *4* and member *5* are rollers *a* and springs *f*. Member *5* rotates freely about axis *B*. When link *4* turns counterclockwise, rolls *a* are jammed between link *4* and member *5*, turning the latter in the same direction. When cam *1* rotates continuously, member *5* rotates intermittently counterclockwise. The amplitude of oscillation of link *4* is varied by turning lever *6* and locking it in the required position.

3196	TWO-COORDINATE CAM-LEVER MECHANISM FOR TRACING SPECIFIED PATHS	CmL Ge



Face cam *1* rotates about fixed axis *A* and has two profiled grooves *a* and *b*. Follower *4* reciprocates in fixed guides *B-B* along axis *x-x* and carries roller *6* which rolls and slides along groove *a*. Follower *2* reciprocates in fixed guides *C-C* along axis *y-y* and carries roller *5* which rolls and slides along groove *b*. Followers *2* and *4* have slots *c* and *d*. Tool *3*, mounted at the intersection of slots *c* and *d*, traces the required figure, for example, letter K, as shown. The profiles of grooves *a* and *b* are constructed according to the corresponding projections of the required figure on axes *x* and *y*.

3197	DIFFERENTIAL CAM-LEVER MECHANISM FOR TRACING SPECIFIED PATHS	CmL Ge

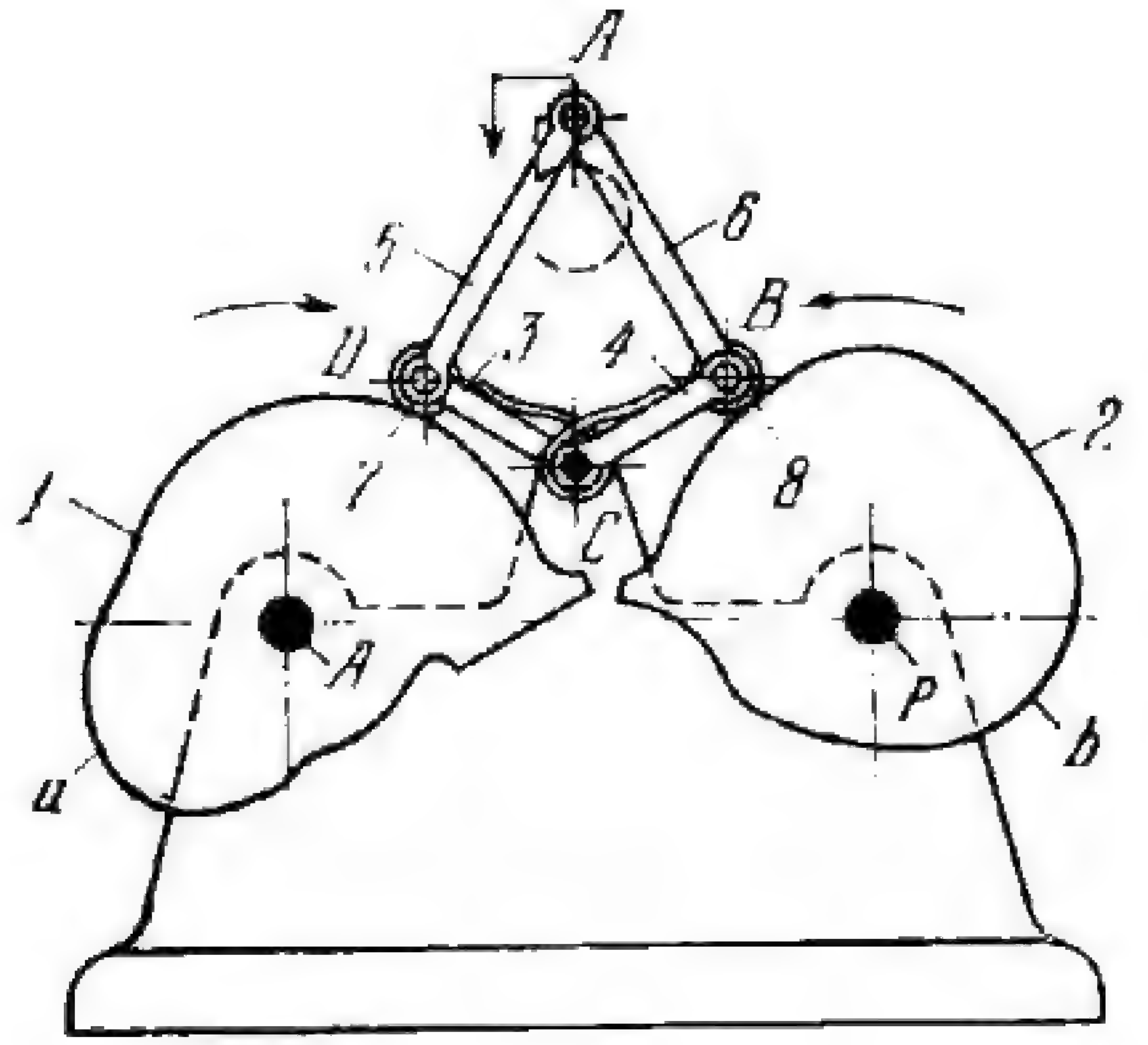


Plate cams *1* and *2* rotate about fixed axes *A* and *P* independently of each other. Followers *3* and *4* oscillate about fixed axis *C* and carry rollers *7* and *8* which roll along the contours *a* and *b* of cams *1* and *2*. Links *5* and *6* are connected by turning pairs *D* and *B* to followers *3* and *4*, and by turning pair *A* to each other. The lengths of the links comply with the conditions: $\overline{CB} = \overline{CD}$ and $\overline{DA} = \overline{BA}$. Rollers *7* and *8* are held in contact with cams *1* and *2* by a flat spring. By proper design of contours *a* and *b* of cams *1* and *2*, and by suitable selection of the angular velocities of the cams, point *A* can be made to trace various paths, for example, to draw the figure 5 as shown.

3198	CAM-LEVER MECHANISM FOR TRACING SPECIFIED PATHS	CmL Ge

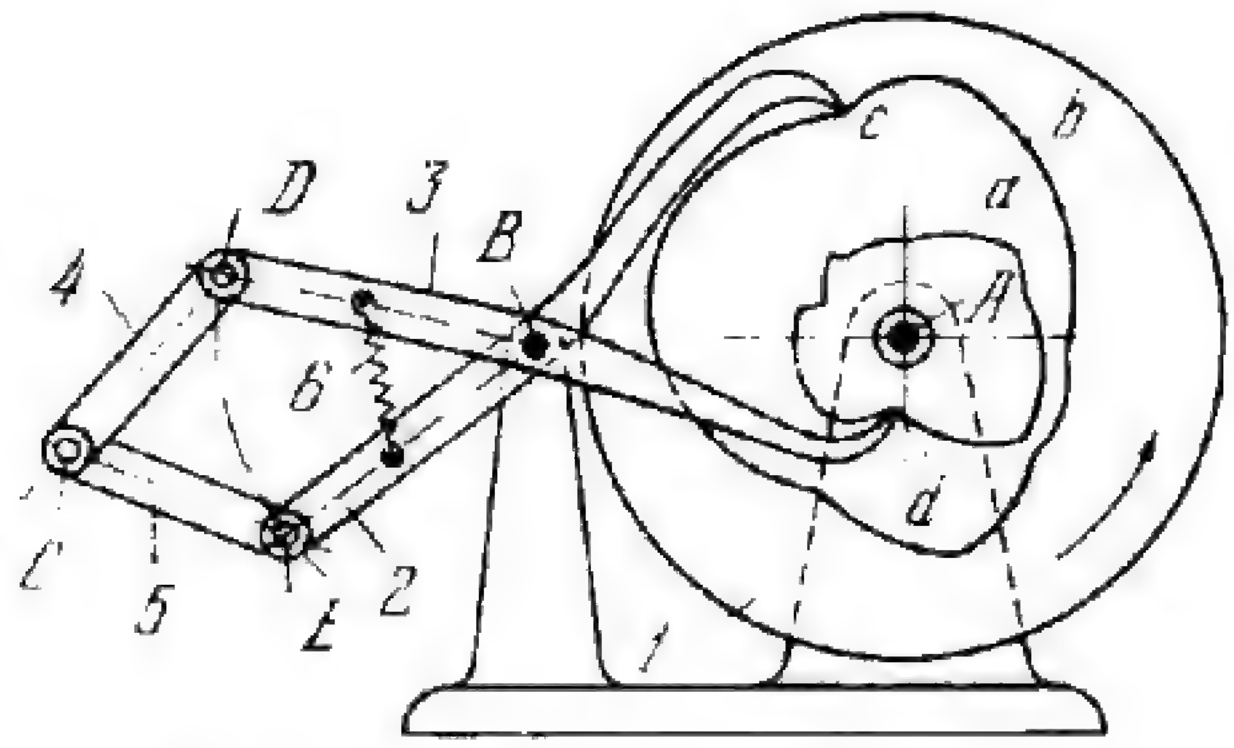
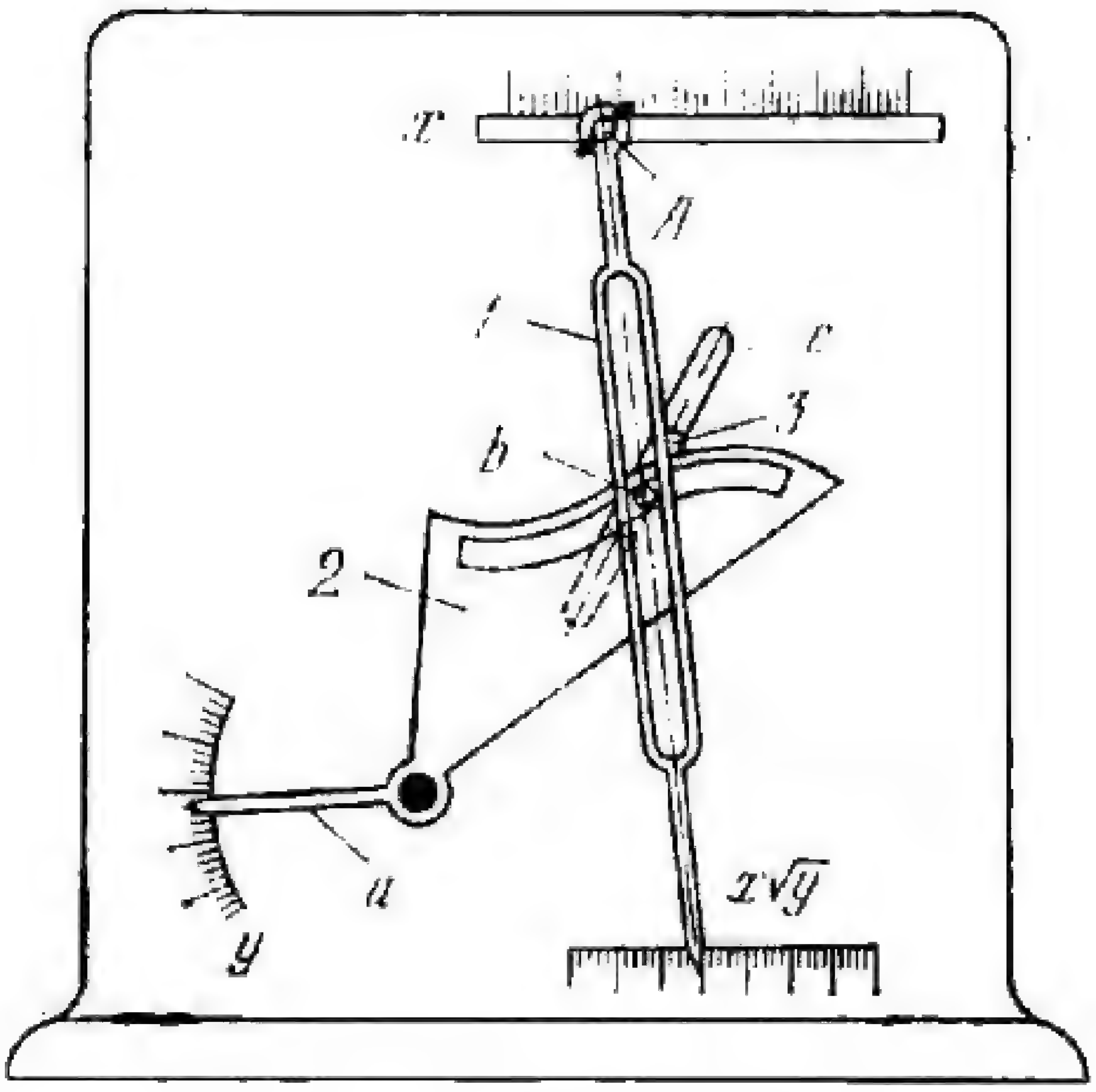


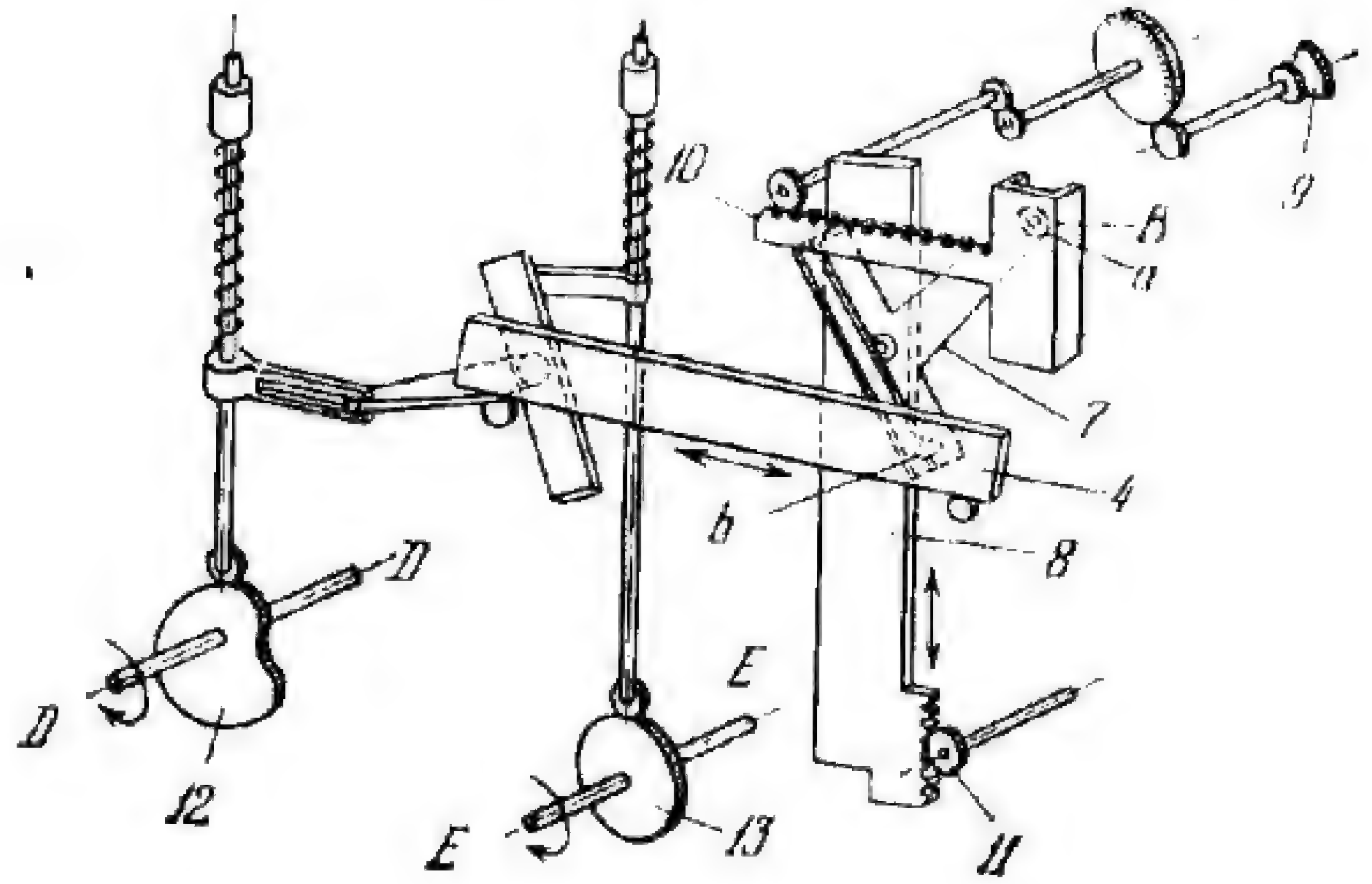
Plate cam *1* rotates about fixed axis *A* and has two contours (working surfaces) *a* and *b*. Followers *2* and *3* oscillate about fixed axis *B* and have knife-edges *c* and *d* which slide along contours *b* and *a*. Links *4* and *5* are connected by turning pairs *D* and *E* to followers *3* and *2*, and by turning pair *C* to each other. The lengths of the links comply with the conditions: $\overline{BD} = \overline{BE}$ and $\overline{CD} = \overline{CE}$. By proper design of contours *a* and *b* of cam *1*, point *C* can be made to trace a specified path. Knife-edges *c* and *d* are held in contact with contours *b* and *a* of cam *1* by spring *6*.

3199	CAM-LEVER MULTIPLYING MECHANISM	CmL MO



The mechanism is used to multiply quantity x by quantity $\sqrt{y}$. Pivot A of slotted link 1 is set to the value x and clamped. Hand a of link 2 is set to the value of y. Pin b of slider 3, moving along fixed guide c, simultaneously passes through the specially profiled groove of link 2 and the slot of link 1. The lower end of link 1 indicates the product $x\sqrt{y}$ on a scale.

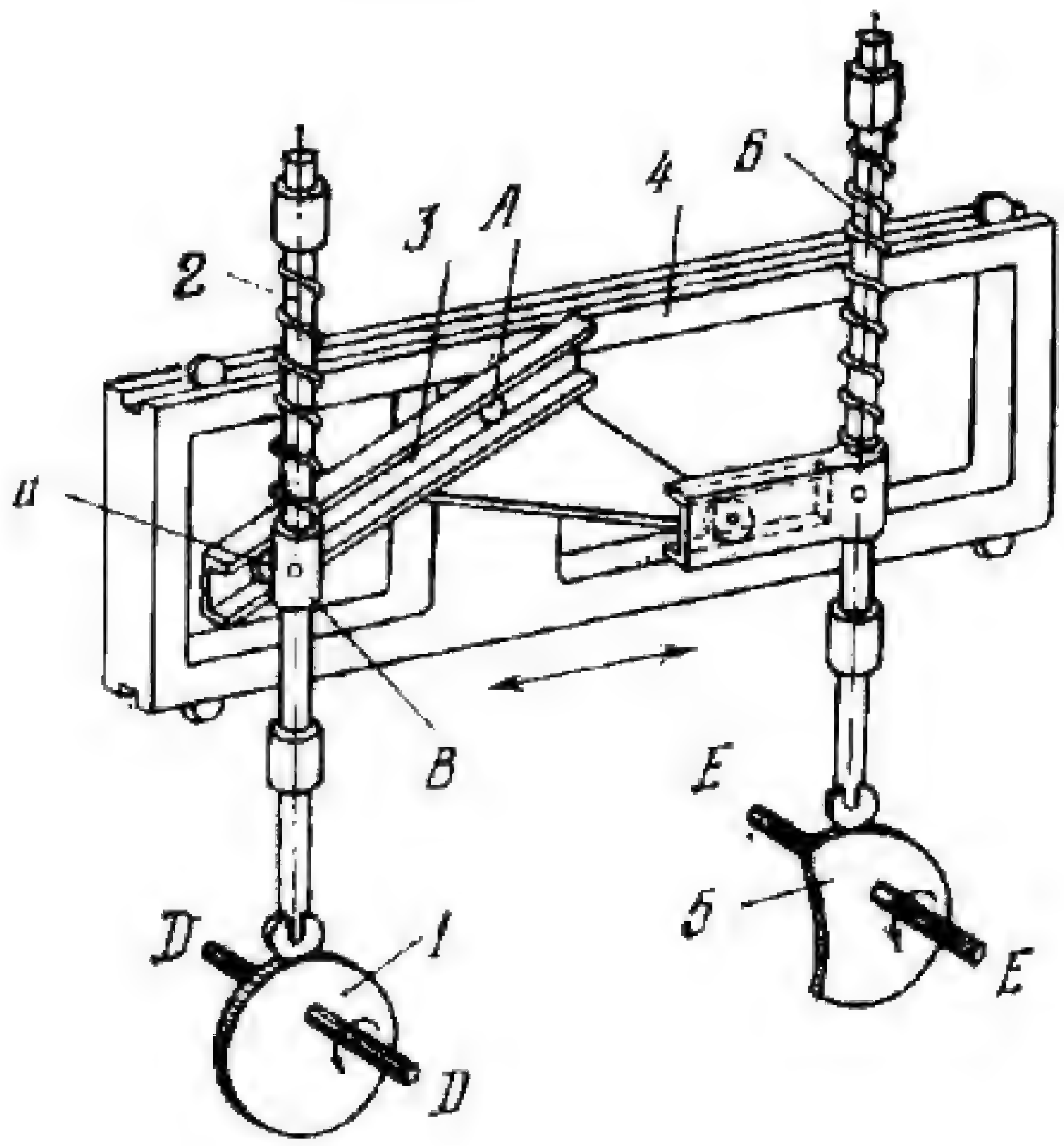
3200	DIFFERENTIAL CAM-LEVER MULTIPLYING MECHANISM	CmL MO



The mechanism is used to determine the product $x \times \sin\alpha \frac{1}{\cos\beta}$.

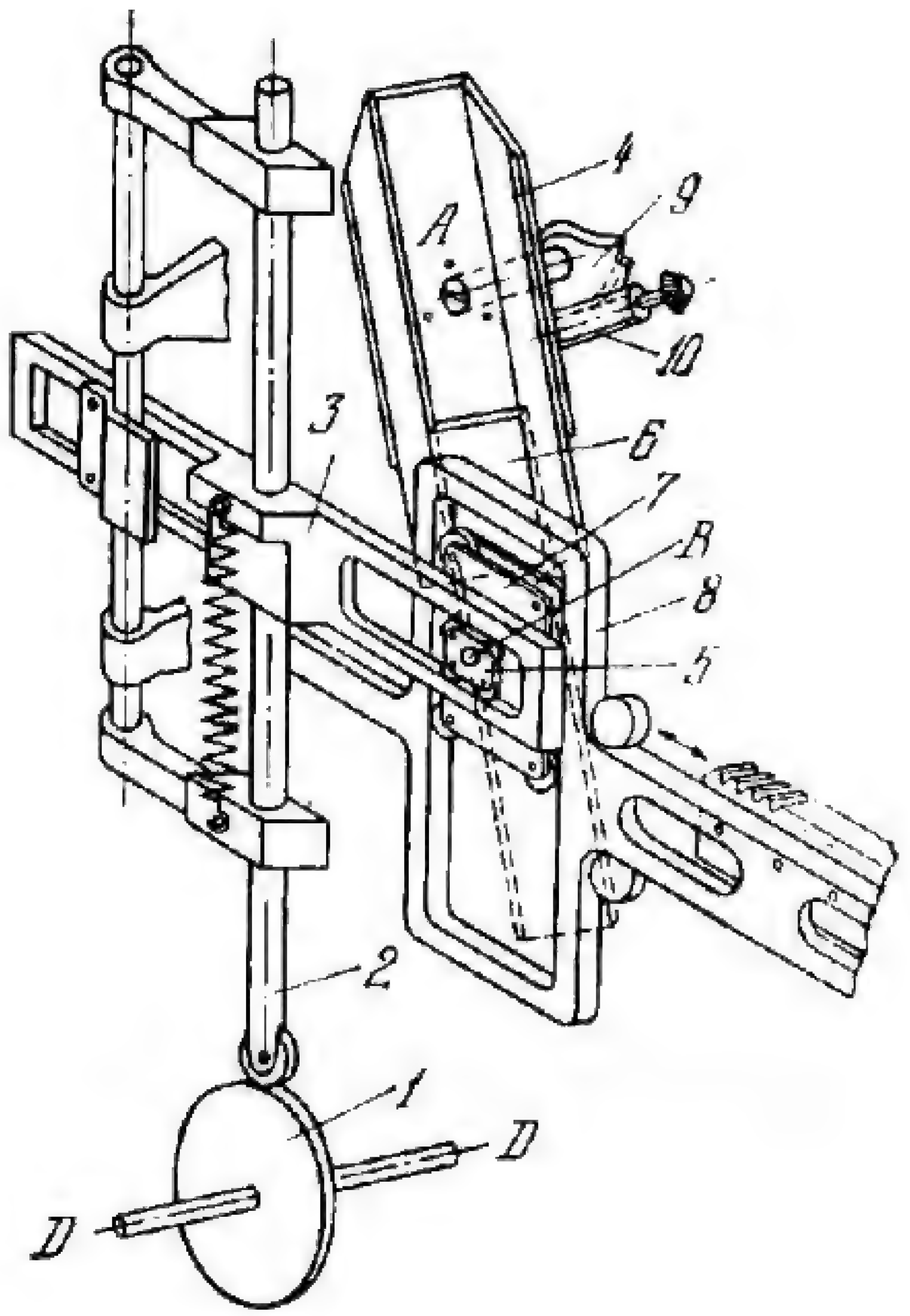
A quantity proportional to $\sin\alpha \frac{1}{\cos\beta}$ is entered by cams *12* and *13* which rotate about fixed axes *D-D* and *E-E*. This value is indicated by strip *4* which travels in the directions shown by the arrows. Strip *4* has a special pin *b* which slides along the groove of channel member *7*. When strip *4* moves, member *7* turns about axis *B* of roller *a*. At this, member *8* is displaced a distance proportional to $\sin\alpha \frac{1}{\cos\beta}$. Quantity *x* is entered by means of handwheel *9* which traverses gear rack *10* through a train of gears. Channel member *7* is thereby turned by roller *a* and the member acts on pin *b* of strip *4* so that member *8* is displaced a distance proportional to *x*. Thus, the resultant displacement of member *8* is proportional to the product $x \times \times \sin\alpha \frac{1}{\cos\beta}$ and is transmitted by rack pinion *11* to the actuating mechanism.

3201	DIFFERENTIAL CAM-LEVER MULTIPLYING MECHANISM	CmL MO



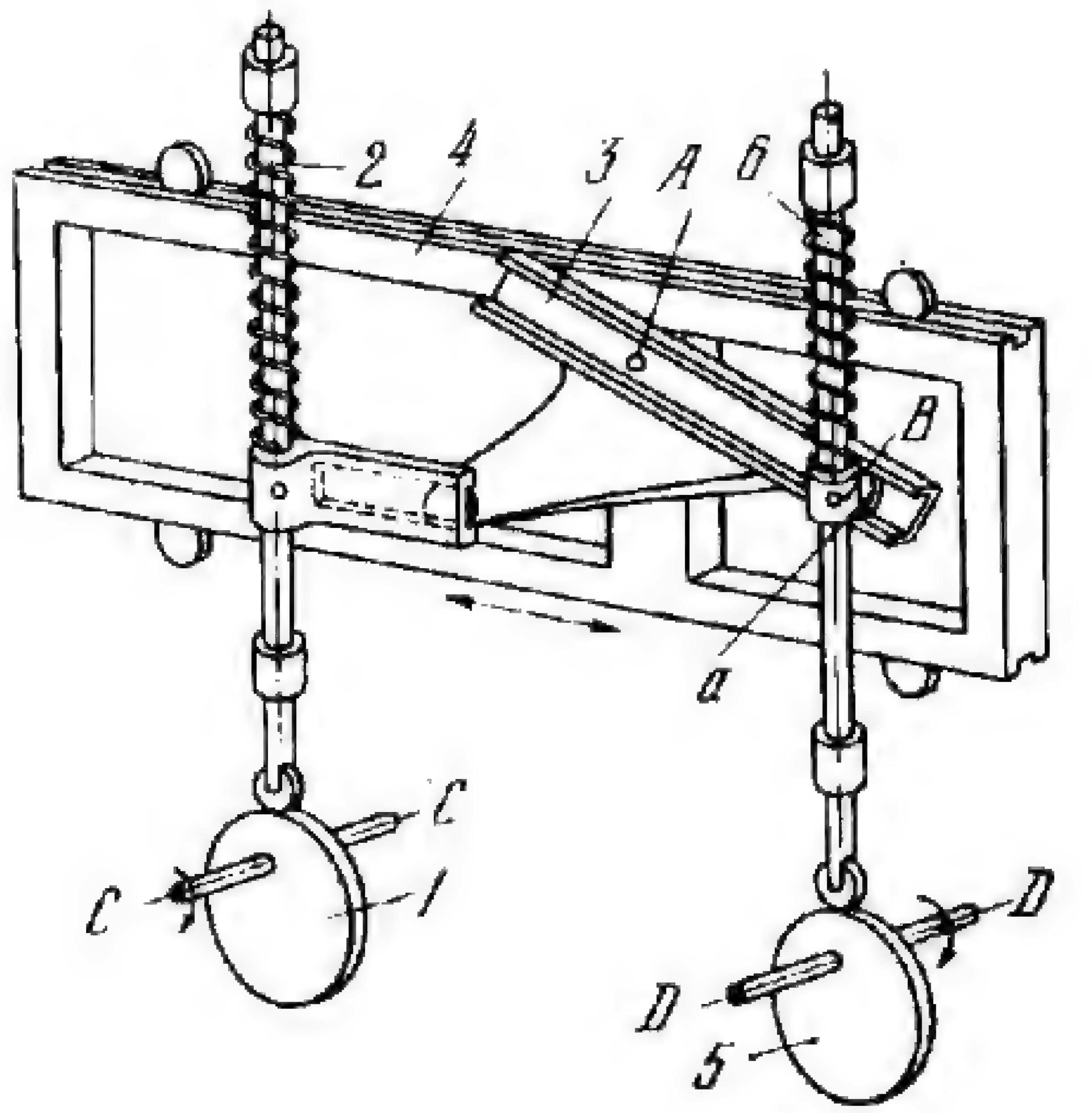
The mechanism is used to determine the product $\sin\alpha \times \frac{1}{\cos\beta}$. When cam *1* is turned about fixed axis *D-D* through the angle α, follower *2* is displaced a distance proportional to $\sin\alpha$, and roller *a*, carried by follower *2*, rolls along the guide of channel member *3*. At this, member *3* moves parallel to itself displacing slide *4*, connected to member *3* by a pivot at point *A*, a distance proportional to $\sin\alpha$. The contour (working surface) of cam *5* is designed so that when it is turned about fixed axis *E-E* through angle β, follower *6* is displaced a distance proportional to $\frac{1}{\cos\beta}$. At this, channel member *3* turns about axis *B* of follower *2* and displaces slide *4* a distance proportional to $\frac{1}{\cos\beta}$. When both cams, *1* and *5*, are turned, slide *4* is displaced in one of the directions shown by the arrows a distance proportional to the product $\sin\alpha \times \frac{1}{\cos\beta}$.

3202	DIFFERENTIAL CAM-LEVER MULTIPLYING MECHANISM	CmL MO



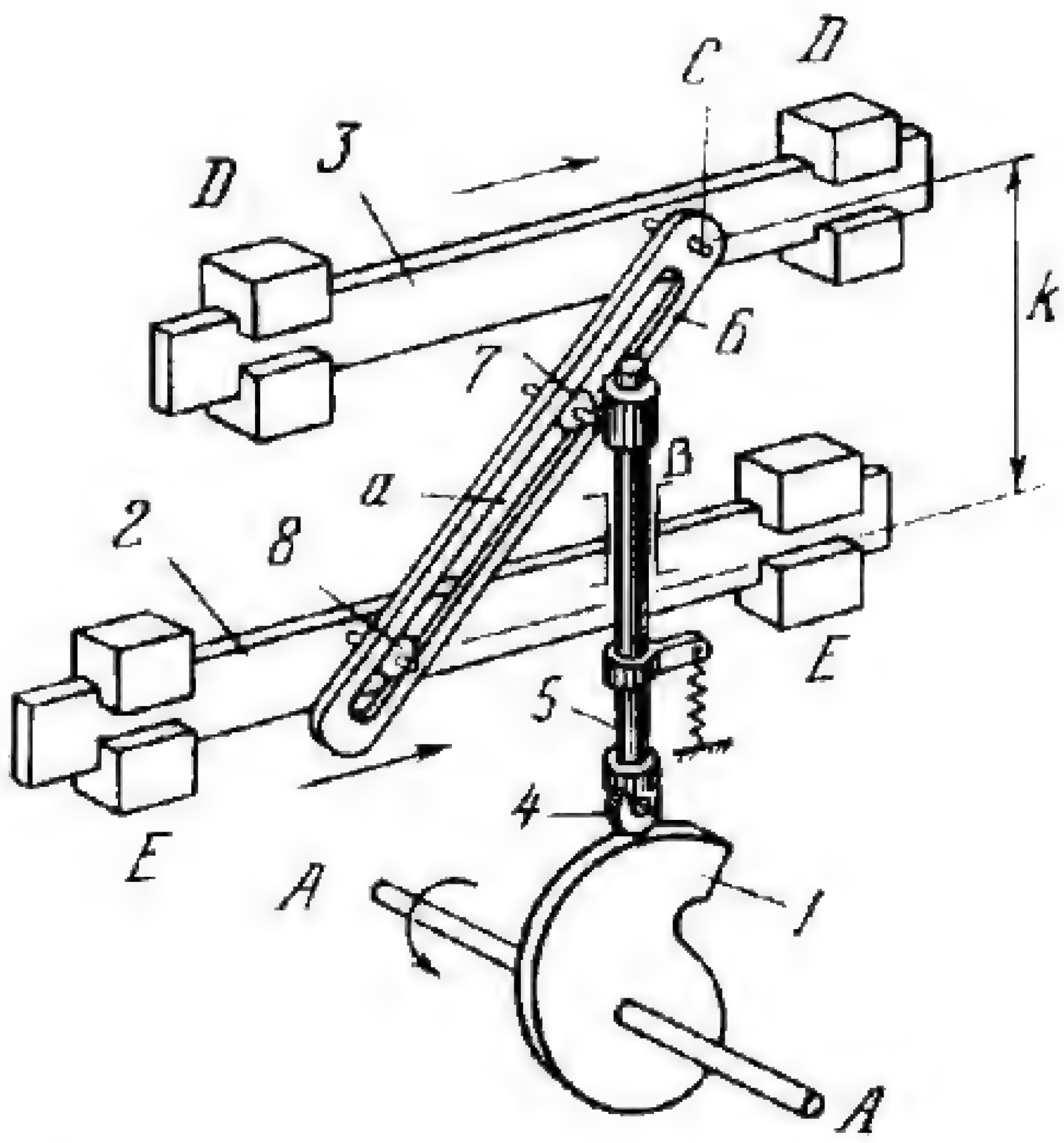
The mechanism is used to determine the product $x \times \sin \alpha$. When cam *1* is turned about fixed axis *D-D* through angle α, follower *2*, together with attached guide member *3*, is displaced a distance proportional to $\sin \alpha$. By means of worm *10* and segment worm wheel *9*, guide member *4* is turned about point *A* through an angle whose tangent is proportional to the quantity x. Three sliders, *5*, *6* and *7*, connected together by turning pair *B*, move along their respective guide members *3*, *4* and *8*, so that the displacement imparted to member *8* is proportional to the product $x \times \sin \alpha$.

3203	DIFFERENTIAL CAM-LEVER MULTIPLYING MECHANISM	CmL MO



The mechanism is used to determine the product $\sin\alpha \times \cos\beta$. When cam *1* is turned about fixed axis *C-C* through angle α, follower *2* is displaced a distance proportional to $\sin\alpha$, and channel member *3*, turning about axis *B* of roller *a*, displaces slide *4*, connected to member *3* by a pivot at point *A*, a distance proportional to $\sin\alpha$. When cam *5* is turned about fixed axis *D-D* through angle β, follower *6* is displaced a distance proportional to $\cos\beta$, and roller *a*, carried by follower *6*, rolls along the groove of member *3*. At this, member *3* is moved parallel to itself, displacing slide *4* a distance proportional to $\cos\beta$. When both cams, *1* and *5*, are turned, slide *4* is displaced in one of the directions shown by the arrows a distance proportional to the product $\sin\alpha \times \cos\beta$.

3204 | DIFFERENTIAL CAM-LEVER MULTIPLYING MECHANISM | CmL MO

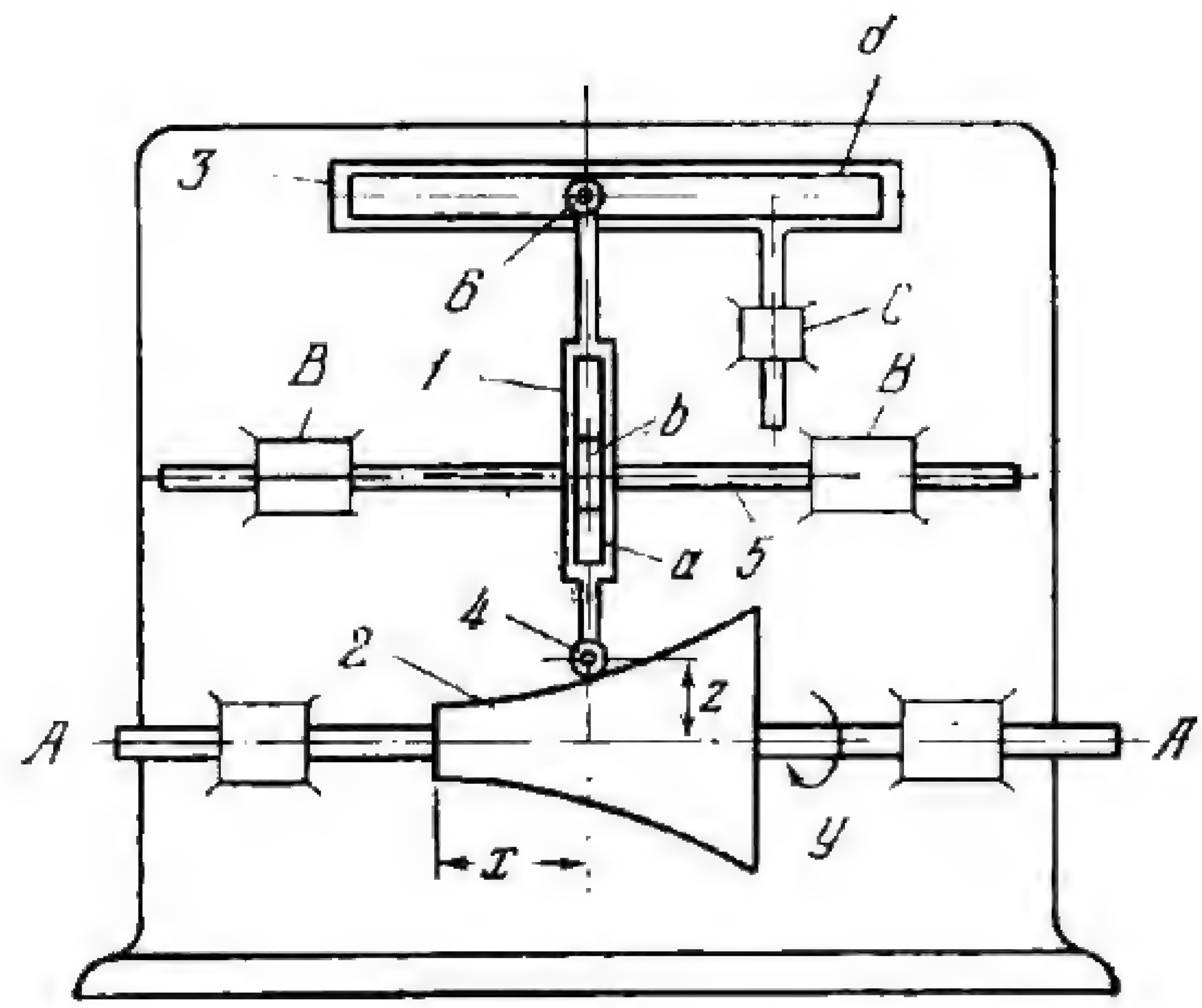


The mechanism is used to multiply two quantities, one being a complex function. Cam *1* rotates about fixed axis *A-A* and, through roller *4*, reciprocates follower *5* in fixed guide *B*. Follower *5* carries roller *7* which rolls along slot *a* of link *6*. Link *6* is connected by turning pair *C* to slide *3* which moves along fixed guides *D-D*. Slide *2* moves along fixed guides *E-E* and carries roller *8* which rolls along slot *a* of link *6*. Displacement s_5 of follower *5* is a complex function, $s_5 = f(\varphi_1)$, of the angle of rotation φ_1 of cam *1*. When cam *1* is rotated through angle φ_1 and slide *2* is moved the distance s_2, slide *3* is displaced a distance equal to

$$s_3 = s_2 \times \frac{k - f(\varphi_1)}{f(\varphi_1)}$$

where k is the constant distance shown.

3205	**DIFFERENTIAL CAM-LEVER MECHANISM FOR GENERATING A FUNCTION OF TWO VARIABLES**	CmL MO

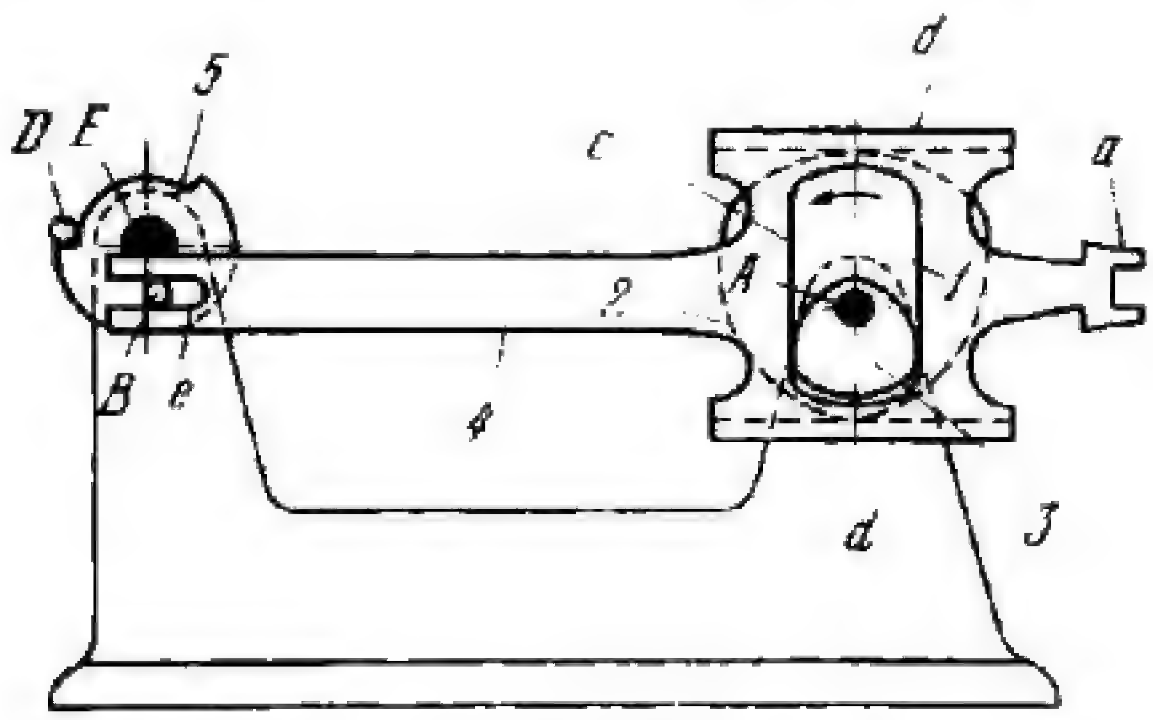


Conoid cam *2* can turn about fixed axis *A-A* and be displaced along this axis. Roller *4* of follower *1* rolls along cam *2*. Follower *1* has slot *a* which slides along block *b* of member *5*. Member *5* can slide in fixed guides *B-B*. Roller *6* of follower *1* rolls along slot *d* of member *3* which can slide in fixed guide *C*. When conoid cam *2* is displaced along axis *A-A* a distance proportional to independent variable x, and turned about axis *A-A* through an angle proportional to y, then the displacement of member *3* is proportional to z, i.e.

$$z = z(x, y).$$

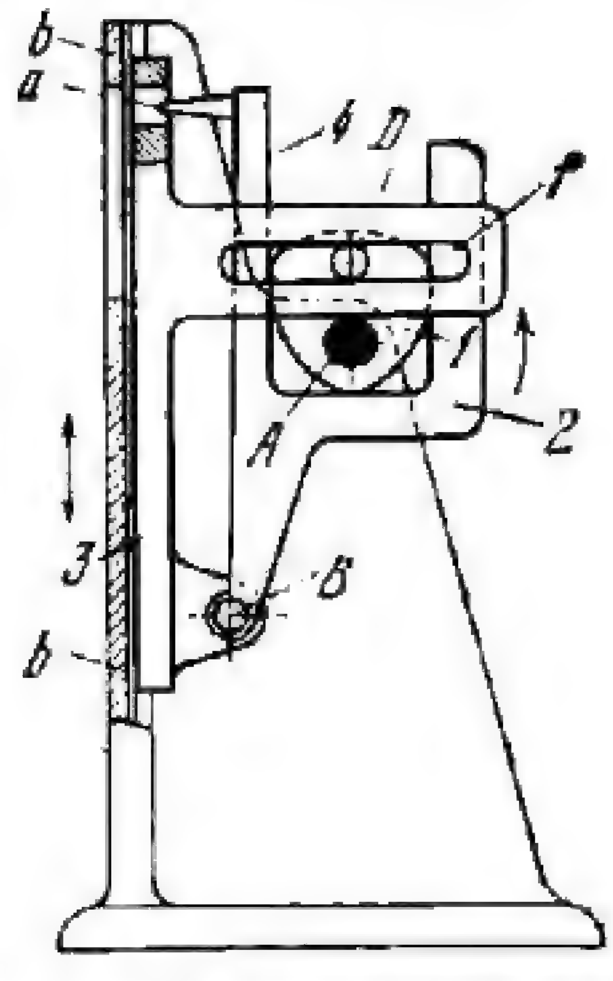
5. OPERATING CLAW MECHANISMS OF MOTION PICTURE CAMERAS (3206 through 3217)

3206	CAM-LEVER OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH VARIABLE PATH OF THE CLAW	CmL OC



Rigidly attached cams *2* and *3* rotate about fixed axis *A*. Constant-breadth cam *3* is confined between flat parallel faces *c* of yoke *1* on follower *4*. Constant-breadth cam *2* is confined between flat parallel guide faces *d* of follower *4*. Follower *4* has slot *e* sliding along pin *B* of link *5* which can be turned about fixed axis *E*. When cams *2* and *3* rotate, claws *a* are inserted into perforations of the film, advance the film and are withdrawn from the perforations. The paths of claws *a* can be changed by turning link *5* and clamping it in the required position with locking pin *D*.

3207	CAM-LEVER OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH A PIN ON THE CAM	CmL OC



Constant-breadth cam *1* rotates about fixed axis *A* and is confined between the flat faces of yoke *4* on follower *2* which turns about axis *B* of slide *3*. Slide *3* reciprocates along fixed guides *b-b*. Cam *1* carries pin *D* which slides along slot *f* of slide *3*. When cam *1* rotates, claw *a* is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3208	CAM-LEVER OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH AN ELASTIC LINK	CmL OC

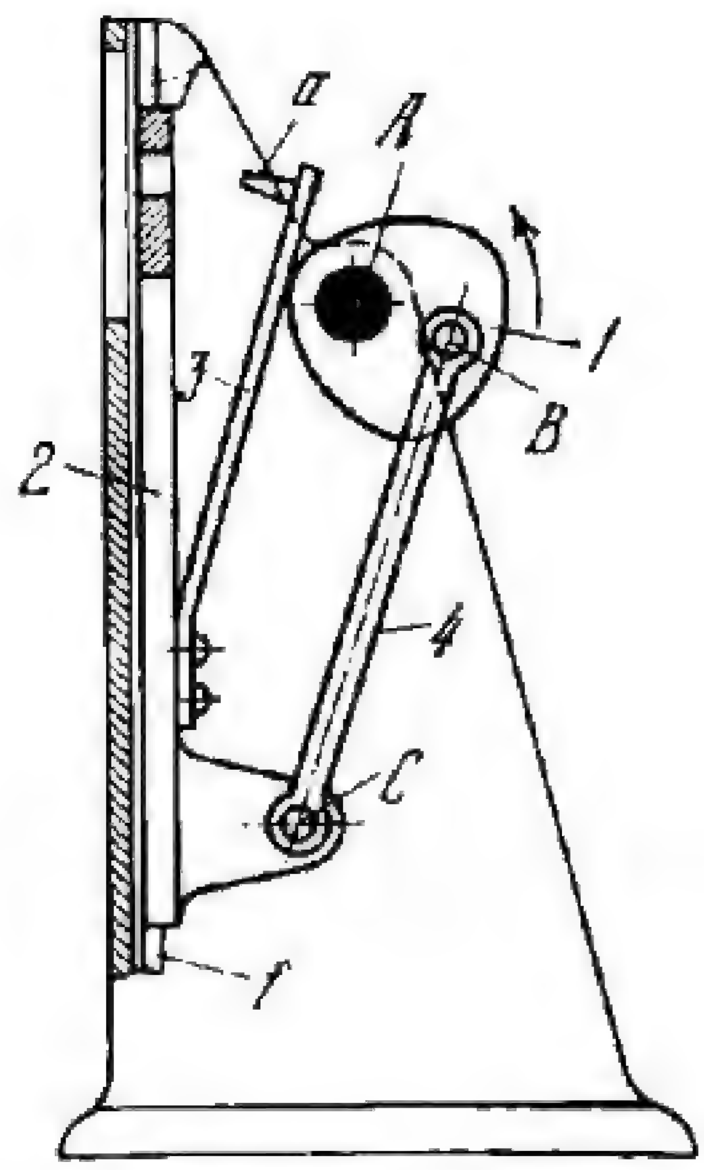
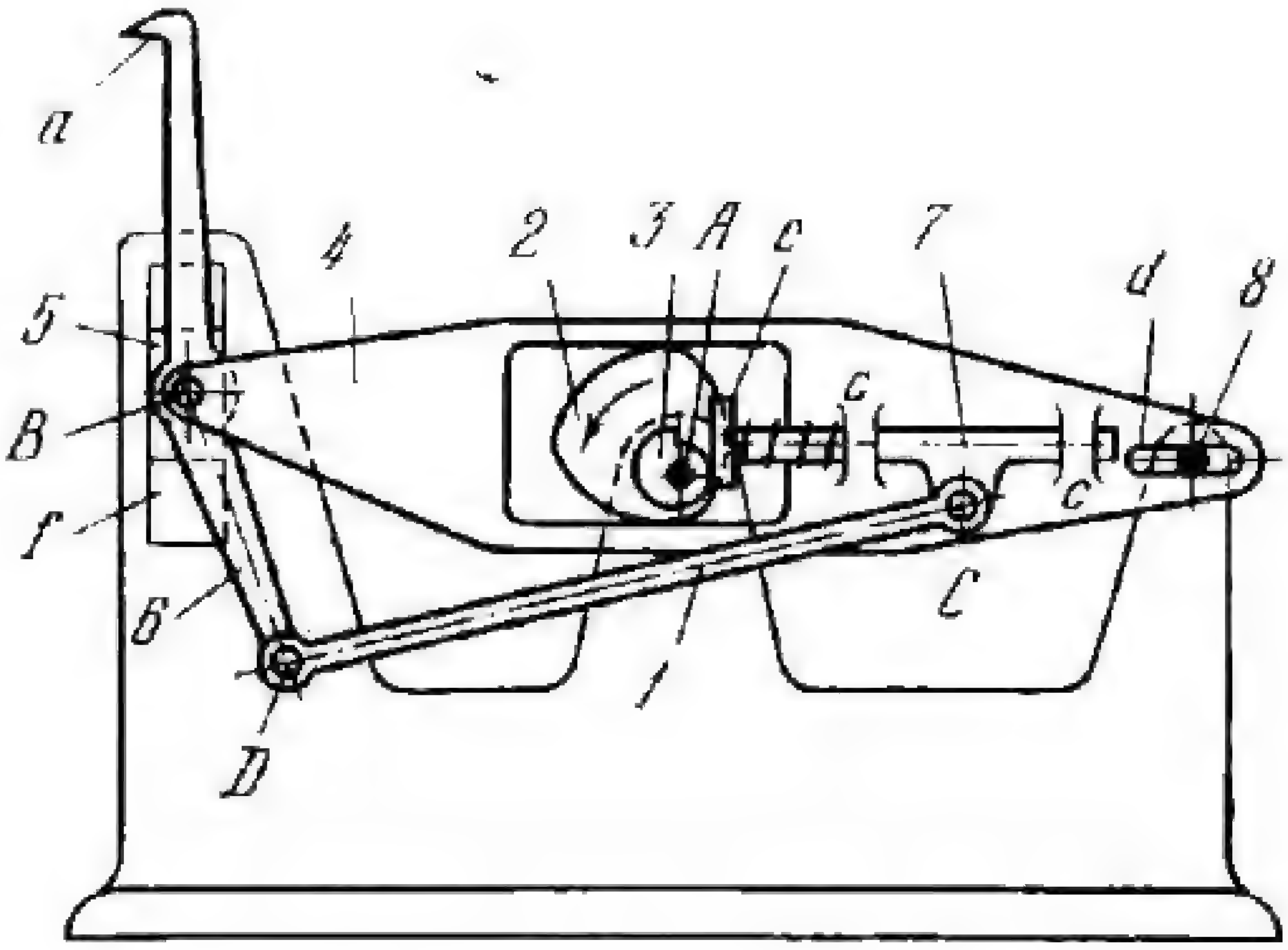


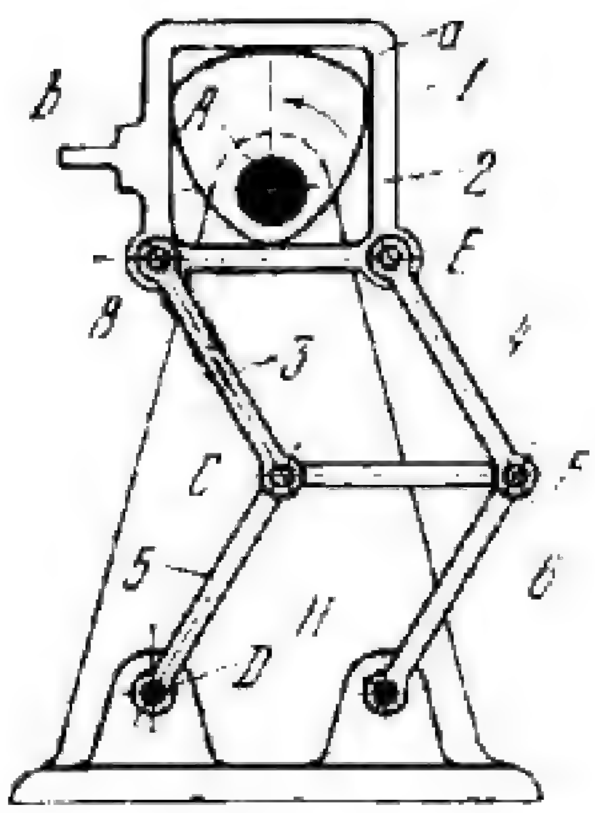
Plate cam *1* rotates about fixed axis *A* and is connected by turning pair *B* to link *4* which, in turn, is connected by turning pair *C* to slide *2*. Slide *2* reciprocates along fixed guides *f-f*. Rigidly attached to slide *2* is flat spring *3* which contacts the working surface of cam *1* and has claw *a*. When cam *1* rotates, claw *a* is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3209	CAM-LEVER OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH TWO CAMS	CmL OC



Rigidly attached cams *2* and *3* rotate about fixed axis *A*. Constant-breadth cam *2* is confined between the parallel flat faces of the yoke in follower *4* which has slot *d* sliding along fixed pin *8*. Follower *4* is connected by turning pair *B* to slide *5* which reciprocates in fixed guide *f*. The working surface of cam *3* slides along flat face *e* of follower *7* which reciprocates in guides *c-c* of follower *4*. Link *1* is connected by turning pairs *C* and *D* to follower *7* and to bellcrank lever *6* which, in turn, is connected by turning pair *B* to slide *5* and has claw *a*. When cams *2* and *3* rotate, claw *a* is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3210	**CAM-LEVER OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH A DOUBLE PARALLELOGRAM**	**CmL** **OC**



Constant-breadth cam *1* rotates about fixed axis A and its contour a is confined between the flat faces of yoke (follower) *2* which has claw b. Yoke *2* is connected by turning pairs B and E to links *3* and *4* which, in turn, are connected by turning pairs C and F to links *5* and *6*. Links *5* and *6* oscillate about fixed axes D and H. The lengths of the links comply with the conditions: $\overline{BC} = \overline{EF}$, $\overline{DC} = \overline{HF}$ and $\overline{BE} = \overline{CF} = \overline{DH}$, i.e. figure $BEFHDCB$ is a double parallelogram. When cam *1* rotates, yoke *2* has a complex motion in which claw b is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3211	**CAM-LEVER OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH A FLAT SPRING**	**CmL** **OC**

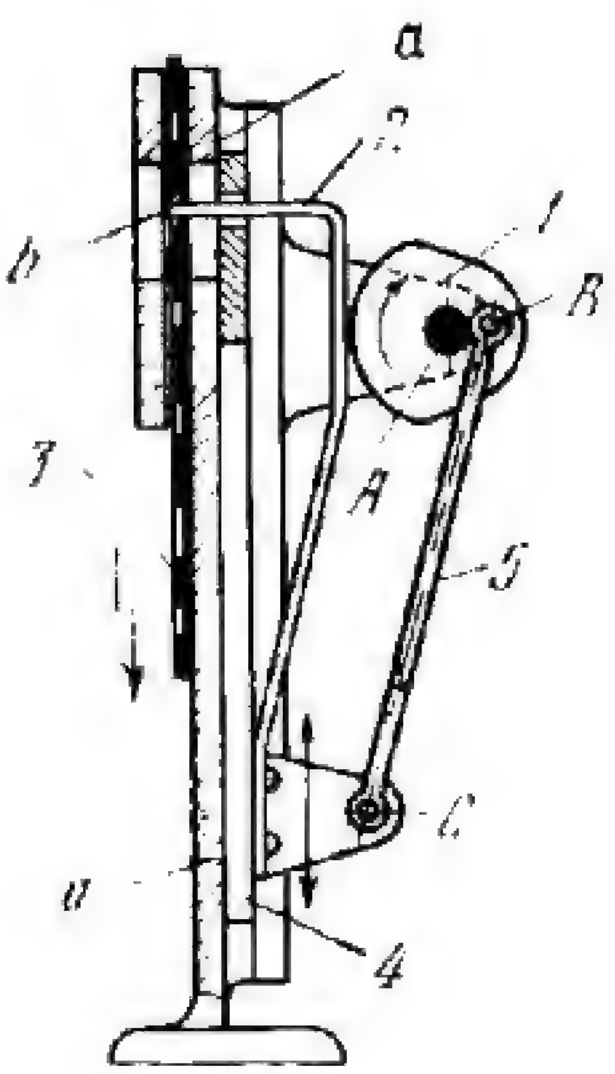
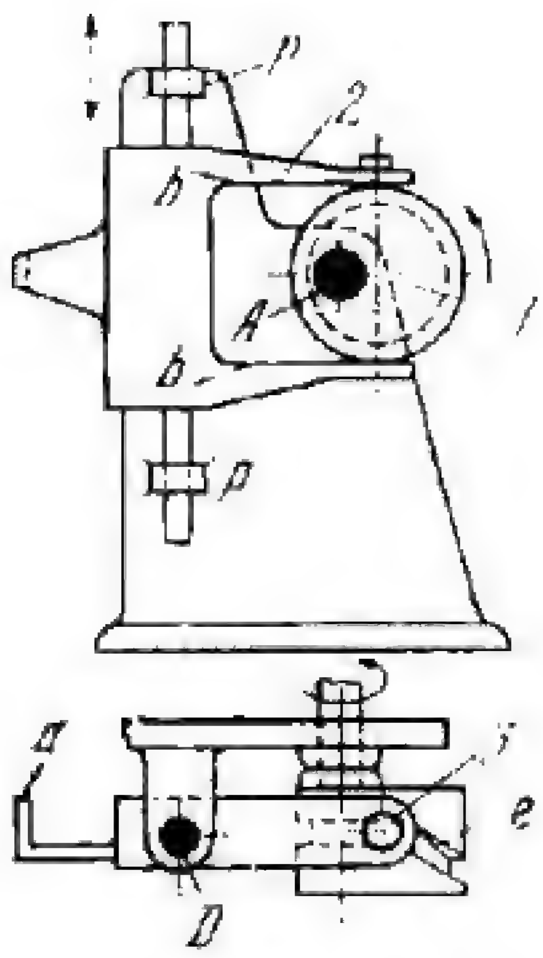


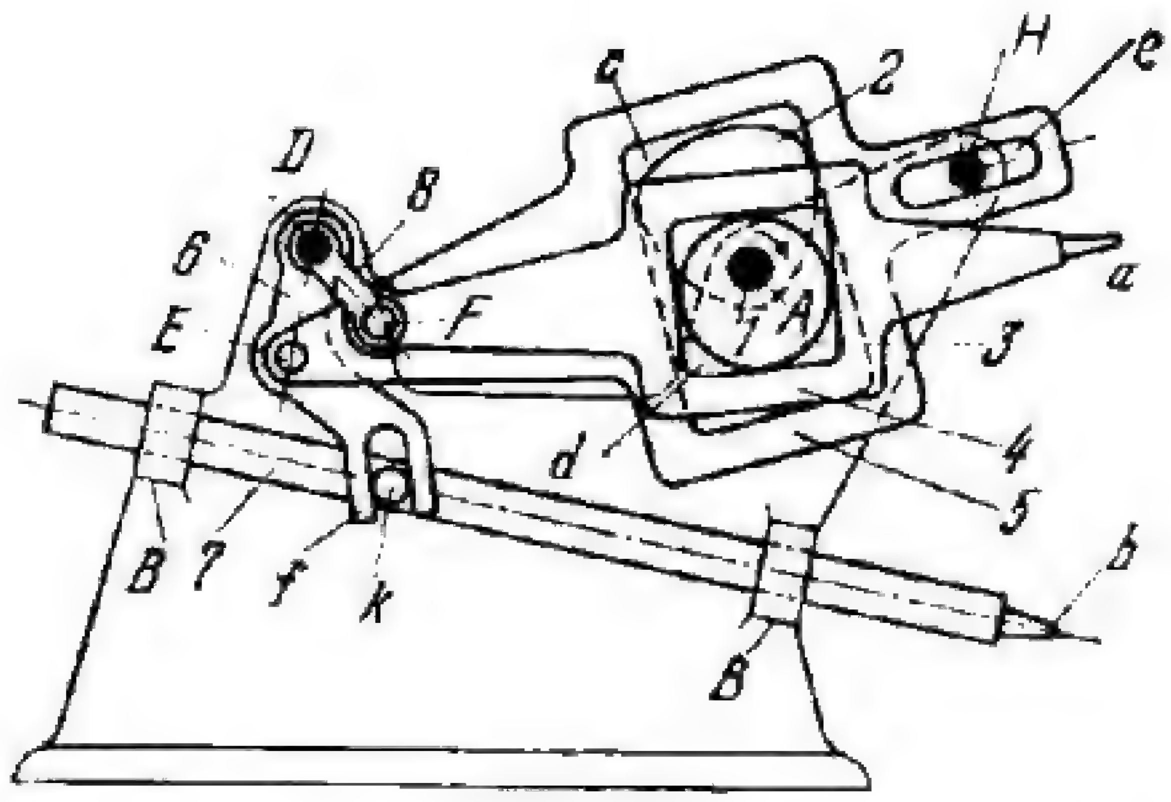
Plate cam *1* rotates about fixed axis A. Connecting rod *5* is connected by turning pairs B and C to cam *1* and to slide *4* which reciprocates along fixed guides a-a. Rigidly attached to slide *4* is flat spring *2* which contacts the working surface of cam *1*. When cam *1* rotates, claw b of spring *2* is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3212	CAM-LEVER SPATIAL OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA	CmL OC



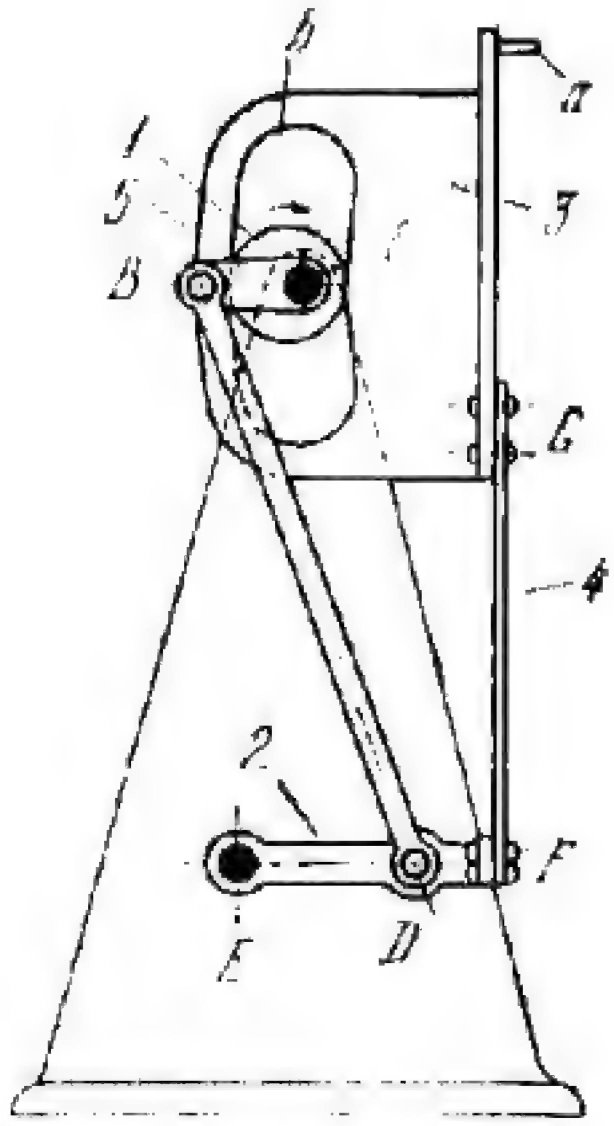
Round eccentric *1* rotates about fixed axis *A*. Follower *2* is designed as a yoke having flat parallel faces *b-b* which are continuously in contact with the circumference of eccentric *1*. Follower *2* carries roller *3* which rolls and slides along continuous groove *e* in the circumference of cam *1*. Follower *2* reciprocates in fixed guides *p-p* and oscillates about fixed axis *D*. Thus, when eccentric *1* rotates, claw *a* of follower *2* has a complex motion, rotary about axis *D* and translatory along guides *p-p*, in which it is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3213	CAM-LEVER OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH CONSTANT-BREADTH CAMS	CmL OC



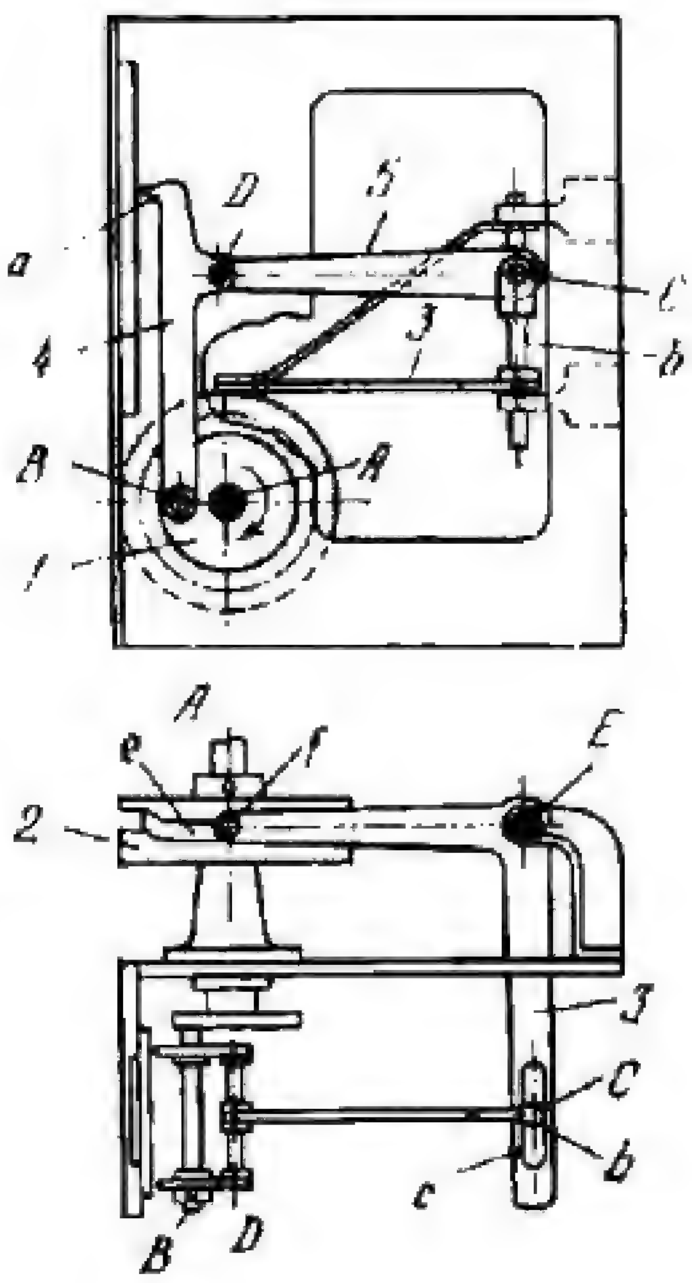
Constant-breadth cam *2* and round eccentric *3* are keyed to shaft *1* and rotate about fixed axis *A*. Link *6* oscillates about fixed axis *D* and is connected by turning pair *E* to follower *5*. Fork *f* of link *6* slides along pin *k* of link *7* which reciprocates in fixed guides *B-B*. Link *8* oscillates about axis *D* and is connected by turning pair *F* to follower *4*. Eccentric *3* is confined between the flat faces of square yoke *d* of follower *4* which carries claw *a*. Cam *2* is confined between the flat faces of square yoke *c* of follower *5* whose slot *e* slides along fixed pin *H*. The motion of follower *5* is transmitted by link *6* to link *7* which carries claw *b*. When shaft *1* rotates, claw *a* describes a complex curve in which it is inserted into a perforation of the film, advances the film and is withdrawn from the perforation. Claw *b* is inserted into a perforation to restrain the film from movement at the moment that claw *a* is being withdrawn.

3214	CAM-LEVER OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH AN ELASTIC LINK	CmL OC



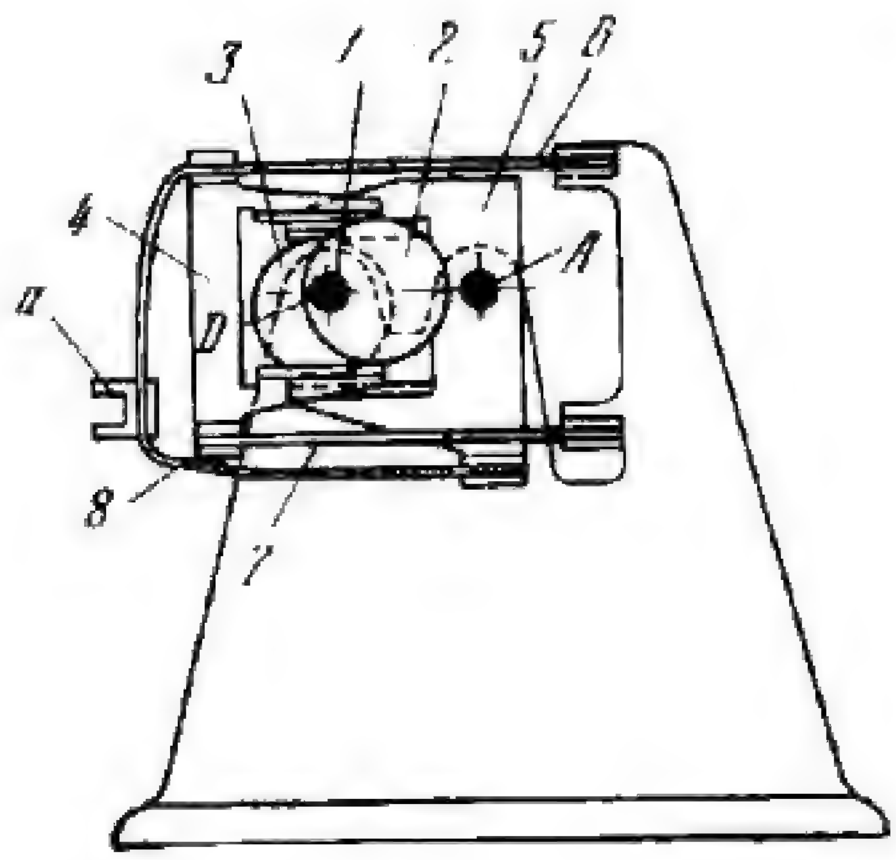
Rigidly attached crank 5 and round eccentric 1 rotate about fixed axis C. One end of flat spring 4 is attached at point F to rocker arm 2 of four-bar linkage CBDE. The other end of spring 4 is attached at point G to yoke 3 whose circular slot b has a width equal to the diameter of eccentric 1. When eccentric 1 and crank 5 rotate, claw a of yoke 3 is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3215	CAM-LEVER SPATIAL OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA	CmL OC



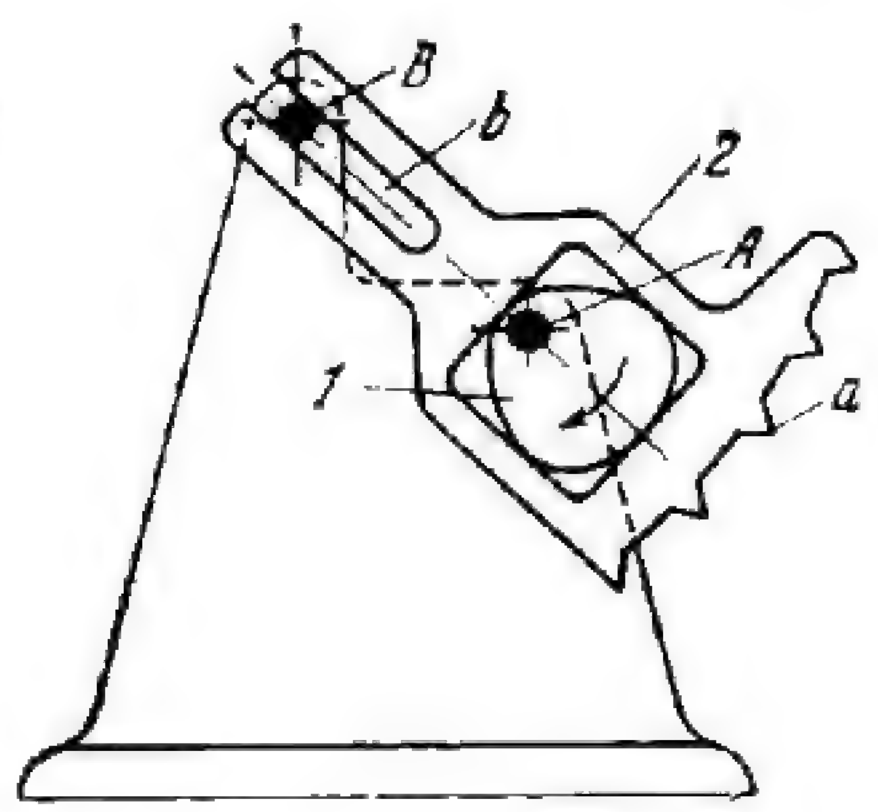
Crank 1 rotates about fixed axis A. Connecting rod 4 is connected by turning pairs B and D to crank 1 and to rocker arm 5 which turns about axis C and has pin b. Pin b slides along slot c of bellcrank lever (follower) 3 which oscillates about fixed axis E and carries pin f. Cylinder cam 2 is rigidly attached to crank 1 and has groove e along which pin f slides. When crank 1 rotates, claw a of connecting rod 4 describes a complex connecting-rod curve, modified by the oscillation of lever 3 leading to displacement of axis C, in which claw a is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3216	CAM-LEVER OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH AN ELASTIC LINK	CmL OC



Round eccentrics *2* and *3* are keyed to shaft *1* and rotate about fixed axis *D*. Eccentric *2* is confined between the flat parallel faces of yoke *4*, and eccentric *3* between the flat parallel faces of yoke *5* which oscillates about fixed axis *A*. Yoke *4* is connected to the base by flat springs *6* and *7*, and to yoke *5* by flat spring *8* on which claws *a* are mounted. When shaft *1* rotates, claws *a* describe complex curves in which they are inserted into perforations of the film, advance the film and are withdrawn from the perforations.

3217	CAM-LEVER OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH A TOOTHED SEGMENT	CmL OC



Constant-breadth cam *1* rotates about fixed axis *A* and is confined between the flat faces of the square yoke of follower *2* whose slot *b* slides along fixed pin *B*. Follower *2* has a toothed segment with claws *a*. When cam *1* rotates, claws *a* describe a complex curve in which they are inserted into perforations of the film, advance the film and are withdrawn from the perforations.

6. HAMMER, PRESS AND DIE MECHANISMS
(3218 through 3223)

3218	CAM-LEVER MECHANISM OF A HORIZONTAL PRESS	CmL HP

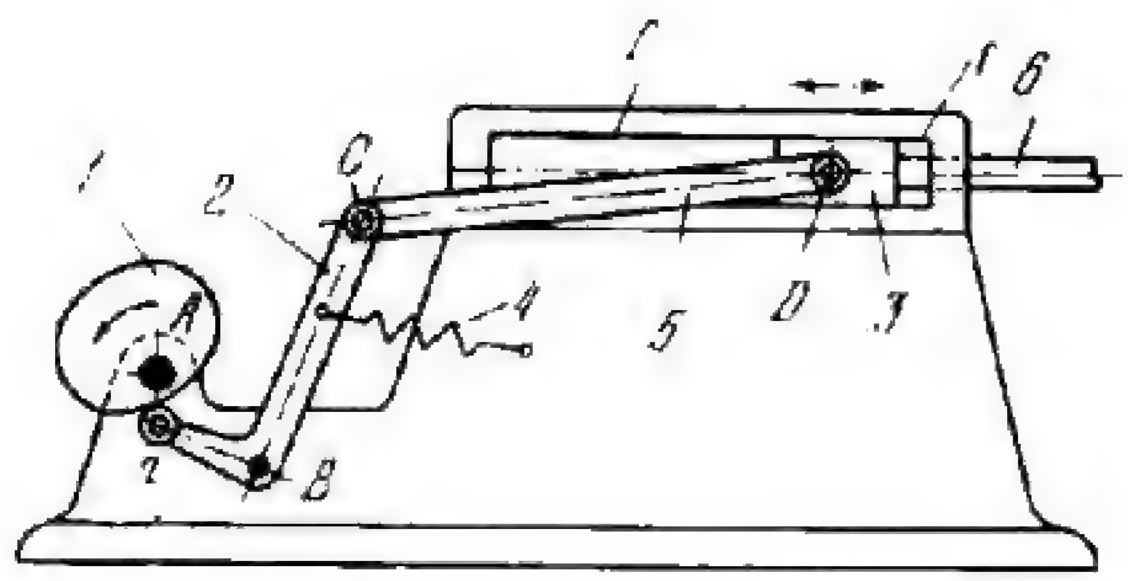


Plate cam *1* rotates about fixed axis *A*. Follower *2* oscillates about fixed axis *B* and carries roller *a* which rolls along the working surface of cam *1*. Link *5* is connected by turning pairs *C* and *D* to follower *2* and to slide *3* which reciprocates in fixed guides *f-f*. Rigidly attached to slide *3* is ram *6* of the pressing device. Roll *a* is held in contact with cam *1* by spring *4*.

3219	CAM-LEVER MECHANISM OF A HORIZONTAL PRESS	CmL HP

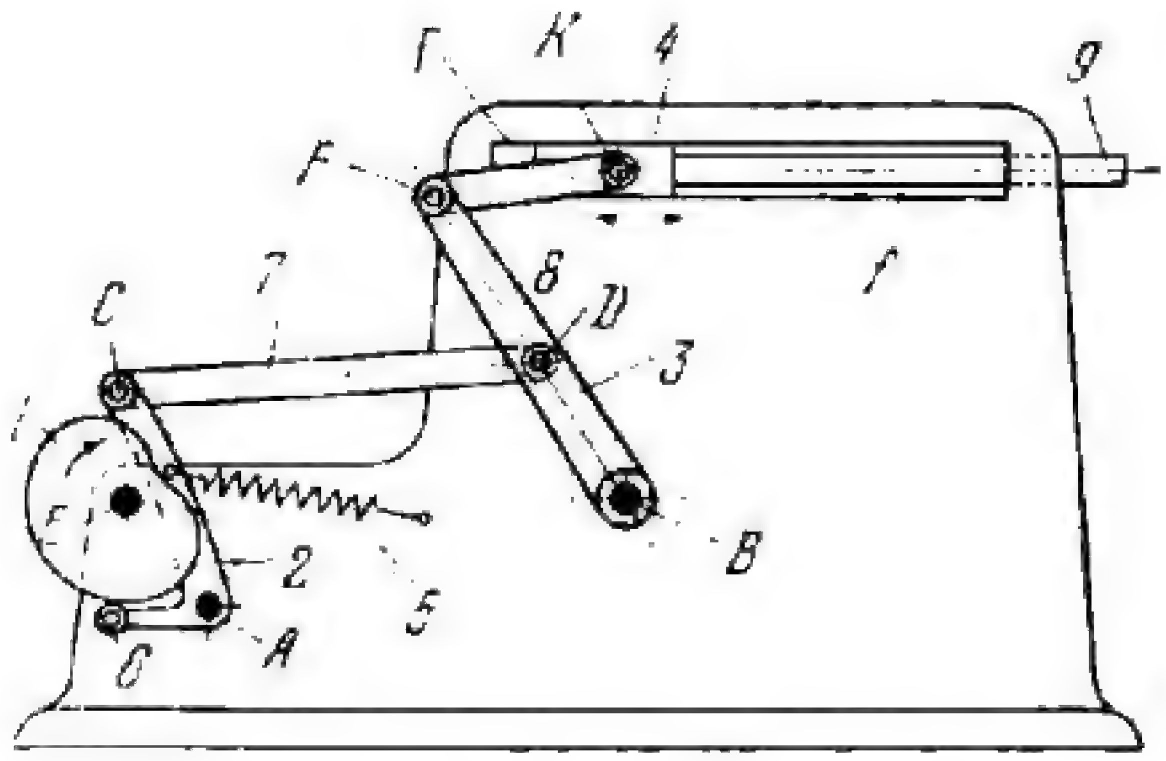
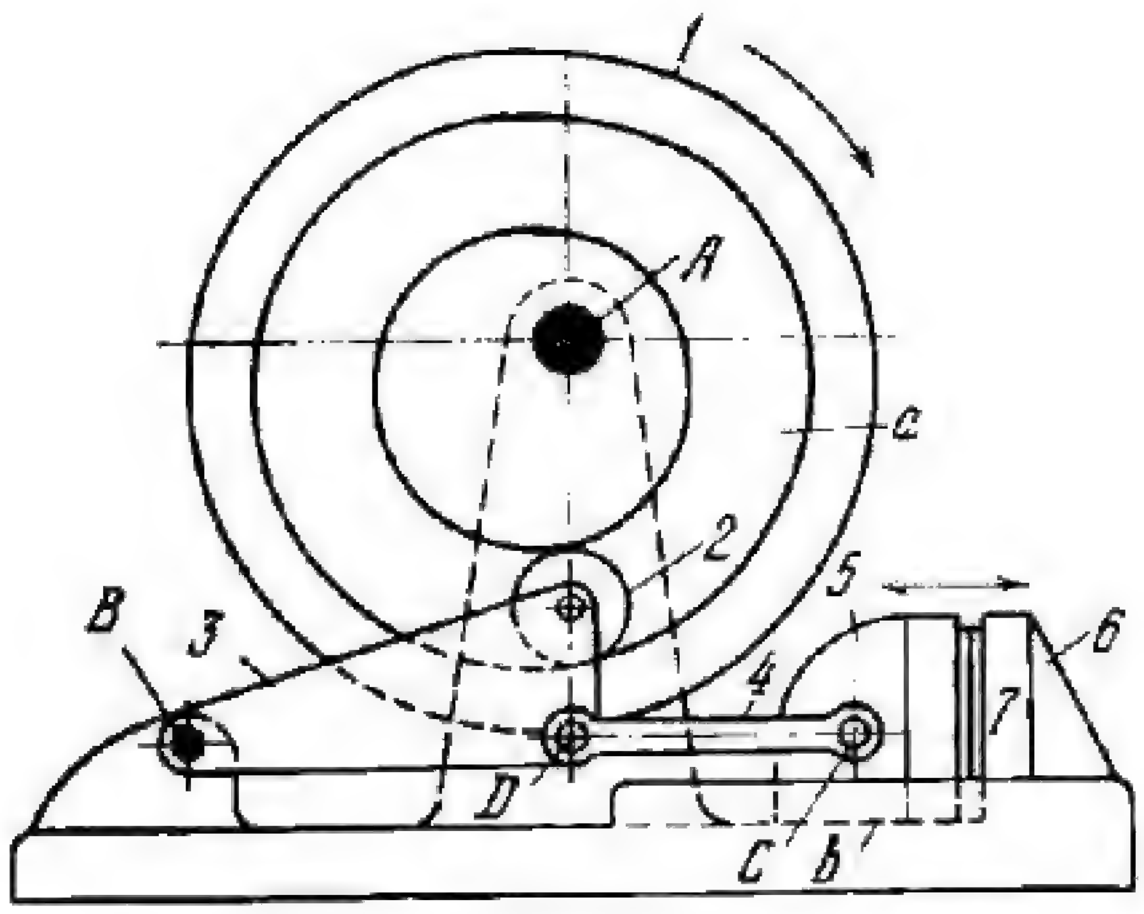


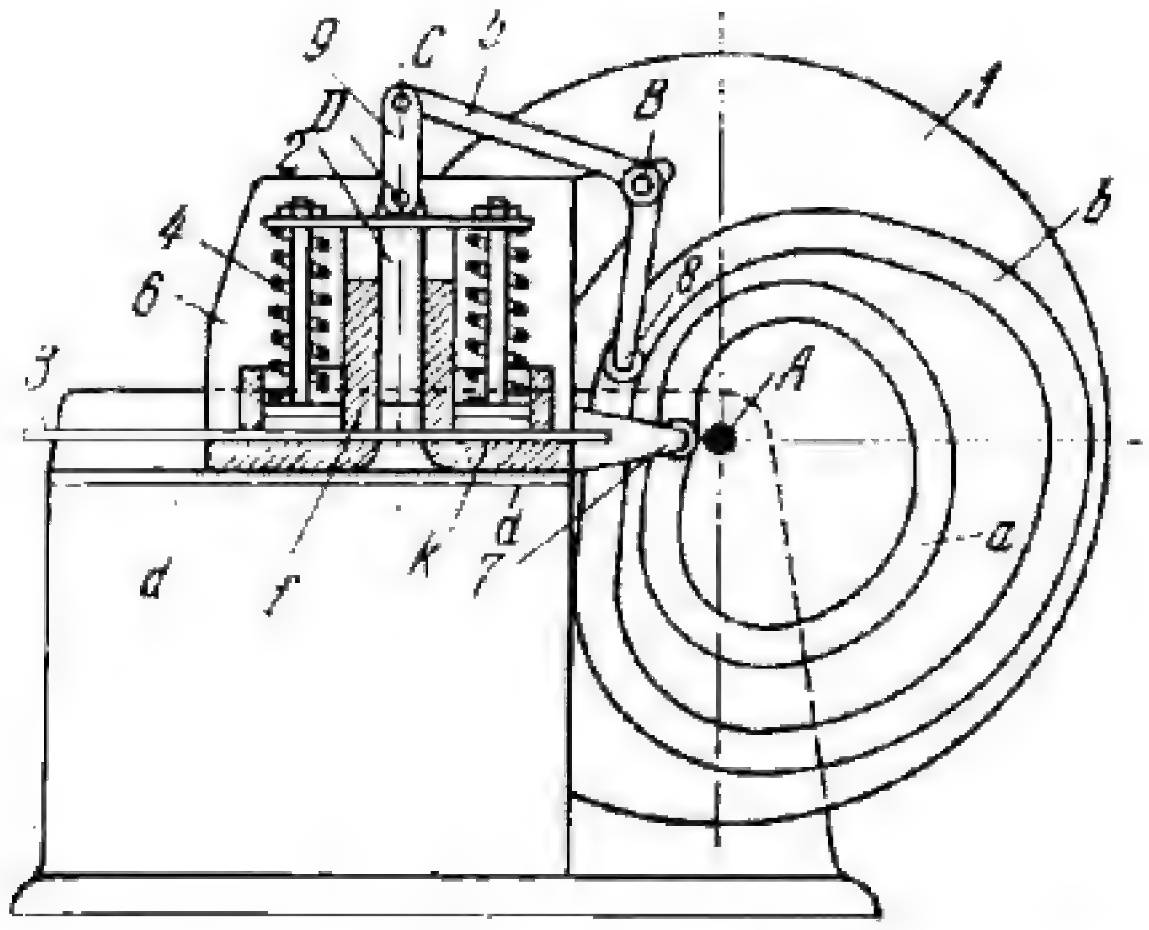
Plate cam *1* rotates about fixed axis *E*. Follower *2* oscillates about fixed axis *A* and carries roller *6* which rolls along the working surface of cam *1*. Link *7* is connected by turning pairs *C* and *D* to follower *2* and to lever *3* which oscillates about fixed axis *B*. Link *8* is connected by turning pairs *F* and *K* to lever *3* and to slide *4* which reciprocates in fixed guides *f-f*. Rigidly attached to slide *4* is ram *9* of the pressing device. Roller *6* is held in contact with cam *1* by spring *5*.

3220	CAM-LEVER MECHANISM OF A HORIZONTAL KNUCKLE-JOINT PRESS	CmL HP



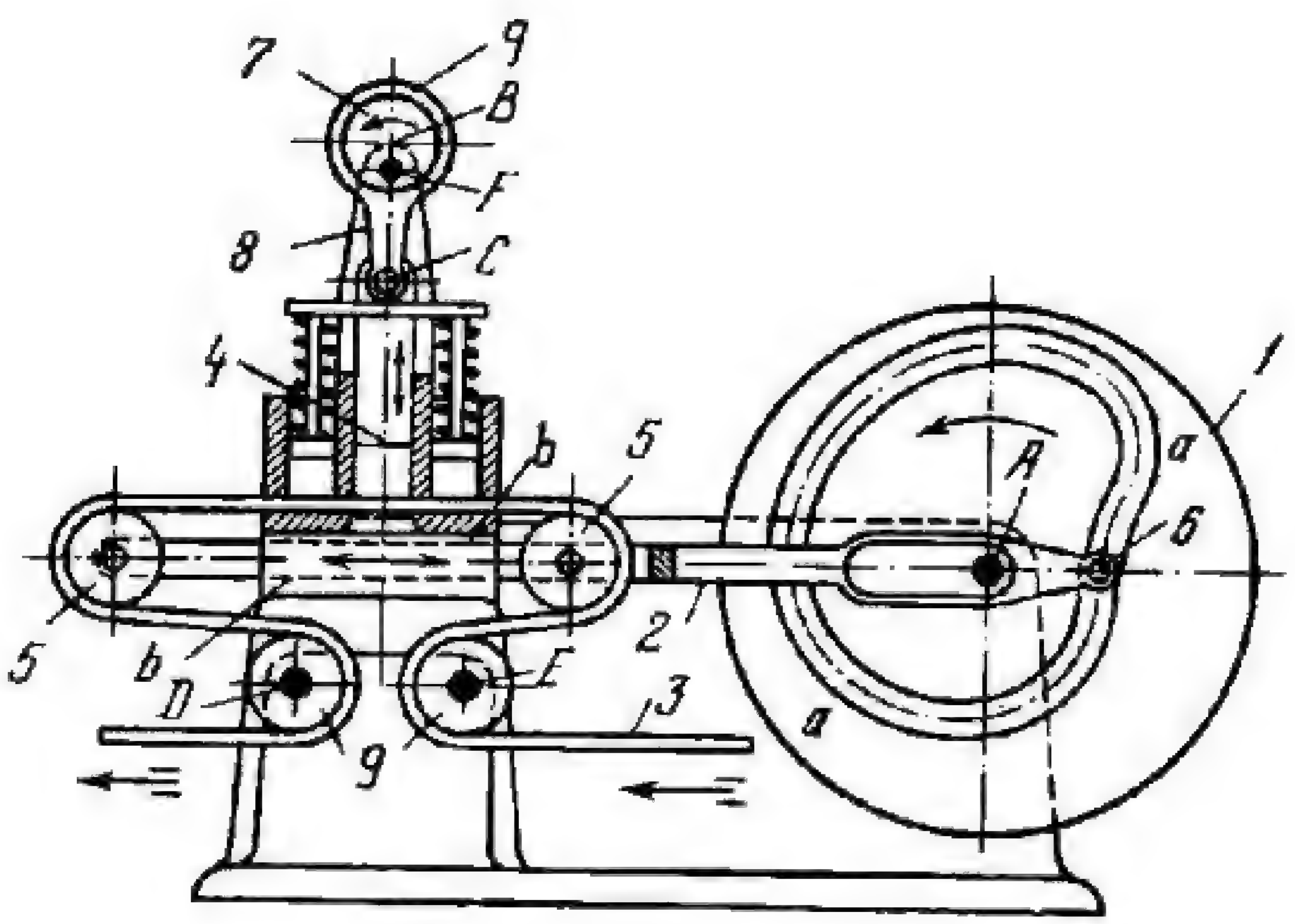
Face cam *1* rotates about fixed axis *A* and has profiled groove *a*. Follower *3* oscillates about fixed axis *B* and carries roller *2* which rolls and slides along groove *a*. Link *4* is connected by turning pairs *D* and *C* to follower *3* and to slide *5* which reciprocates along fixed guide *b*. When cam *1* rotates, slide *5* pressworks stock *7* which is between slide *5* and fixed bed *6*.

3221	CAM-LEVER MECHANISM OF A STAMPING PRESS	CmL HP



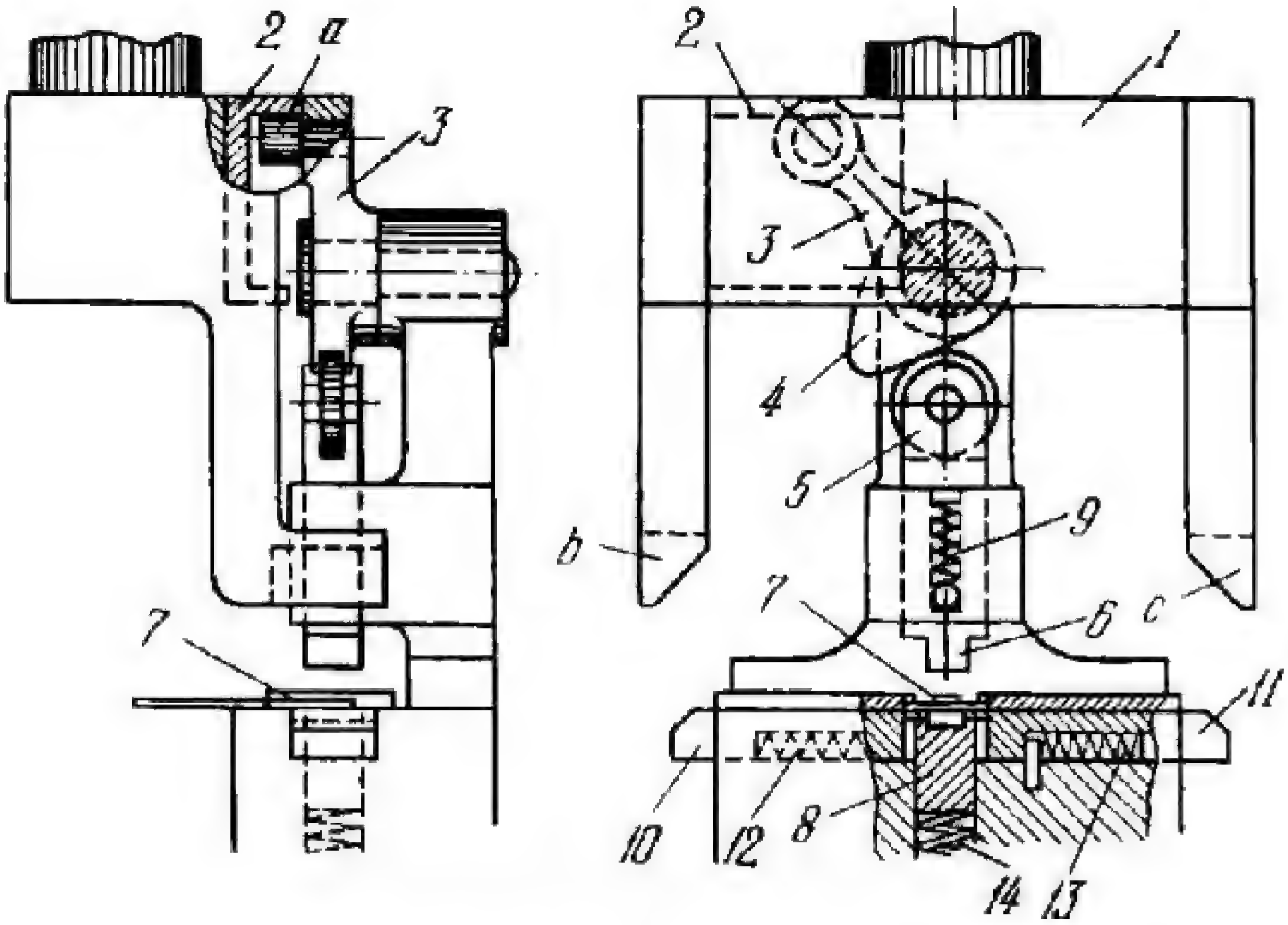
Face cam *1* rotates about fixed axis *A* and has two profiled grooves, *a* and *b*. Carriage *6* reciprocates along fixed guides *d-d* and carries roller *7* which rolls and slides along groove *a*. Bell-crank lever (follower) *5* oscillates about axis *B* of carriage *6* and carries roller *8* which rolls and slides along groove *b*. Link *9* is connected by turning pairs *C* and *D* to lever *5* and to press slide *2* which reciprocates in guide *f* of carriage *6*. When carriage *6* travels to the left, lever *5* and link *9* move press slide *2* axially, simultaneously clamping strip stock *3* with springs *4* against flat surface *k*, and performing the pressworking operation. In the return stroke of carriage *6*, strip stock *3* is released and remains stationary.

3222	CAM-LEVER MECHANISM OF A RAPID-FEED STAMPING PRESS	CmL HP



Face cam *1* rotates about fixed axis *A* and has profiled groove *a*. Follower *2* reciprocates in fixed guides *b-b* and carries roller *6* which rolls and slides along groove *a*. Strip stock *3*, of which the stamping is blanked, runs over rolls *5* of follower *2* and over rolls *9* which rotate about fixed axes *D* and *E*. Press slide *4* is reciprocated by round eccentric *7* which rotates about fixed axis *F*. Pitman *8* has collar *g* encircling eccentric *7* and is connected by turning pair *C* to press slide *4*. Groove *a* is designed so that follower *2* travels to the right at one half the velocity of moving strip stock *3*. This keeps the stock stationary during this period with respect to the axis of slide *4* which performs the pressworking operation (blanking), being actuated by eccentric slider-crank linkage *FBC*. When follower *2* travels to the left, strip stock *3* is rapidly fed through the die.

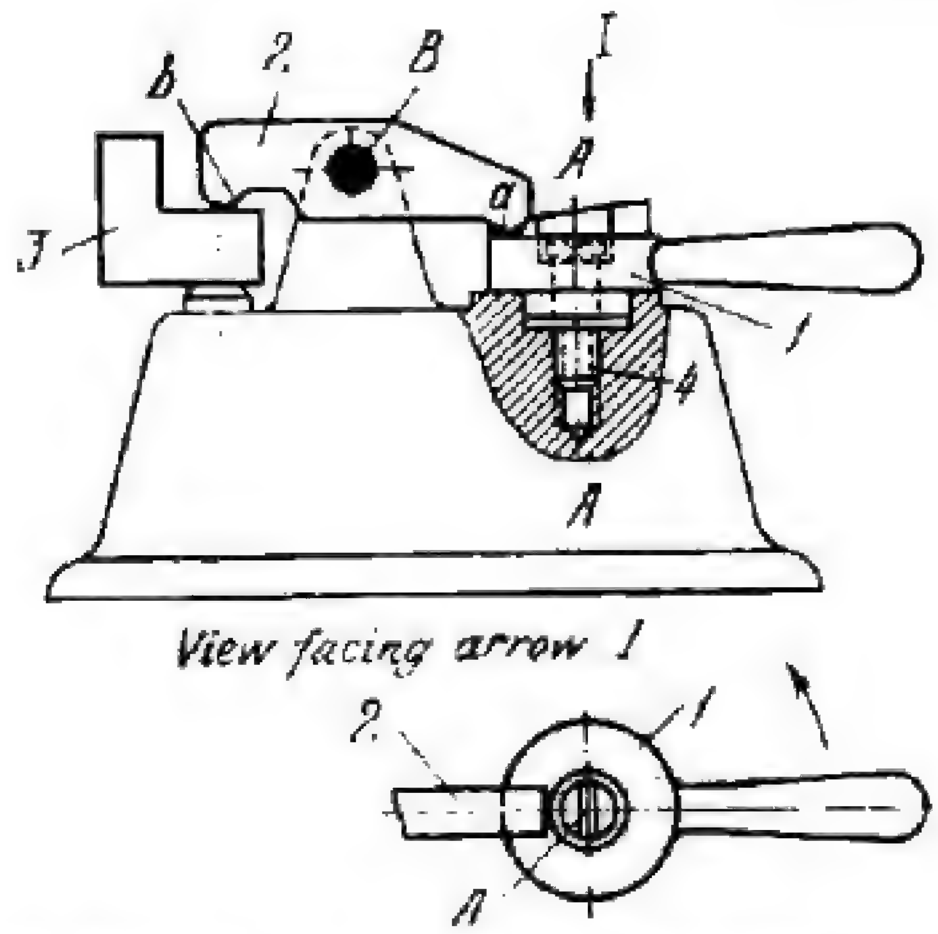
3223 | CAM-LEVER MECHANISM OF A BENDING DIE | CmL HP



In the downstroke of the press slide and punch-holder *1*, the upper flange of member *2* pushes roller *a* downward, turning lever *3* and cam *4* counterclockwise about a fixed axis. As cam *4* turns, it pushes plunger *5* downward so that punch *6* forces work *7* between the ends of side punches *10* and *11* causing the tabs of the work to be bent upward. As the press slide continues moving downward, spring *9* returns plunger *5* to its upper position and cams *b* and *c* apply pressure to sliding side punches *10* and *11*, moving them toward the centre. This bends over the tabs of work 7. As punch-holder *1* begins its upstroke, the lower flange of member *2* turns lever *3* clockwise so that cam *4* again pushes plunger *5* downward and punch *6* presses tightly on the folded tabs of work *7*. At the same time, springs *12* and *13* return side punches *10* and *11* to their initial position. Thus, in one downstroke and one upstroke of punch-holder *1*, three processing operations are performed. Spring *14*, backing up lower die member *8*, compensates for the added thickness of the folded-over tabs and eliminates bottoming of punch *6*.

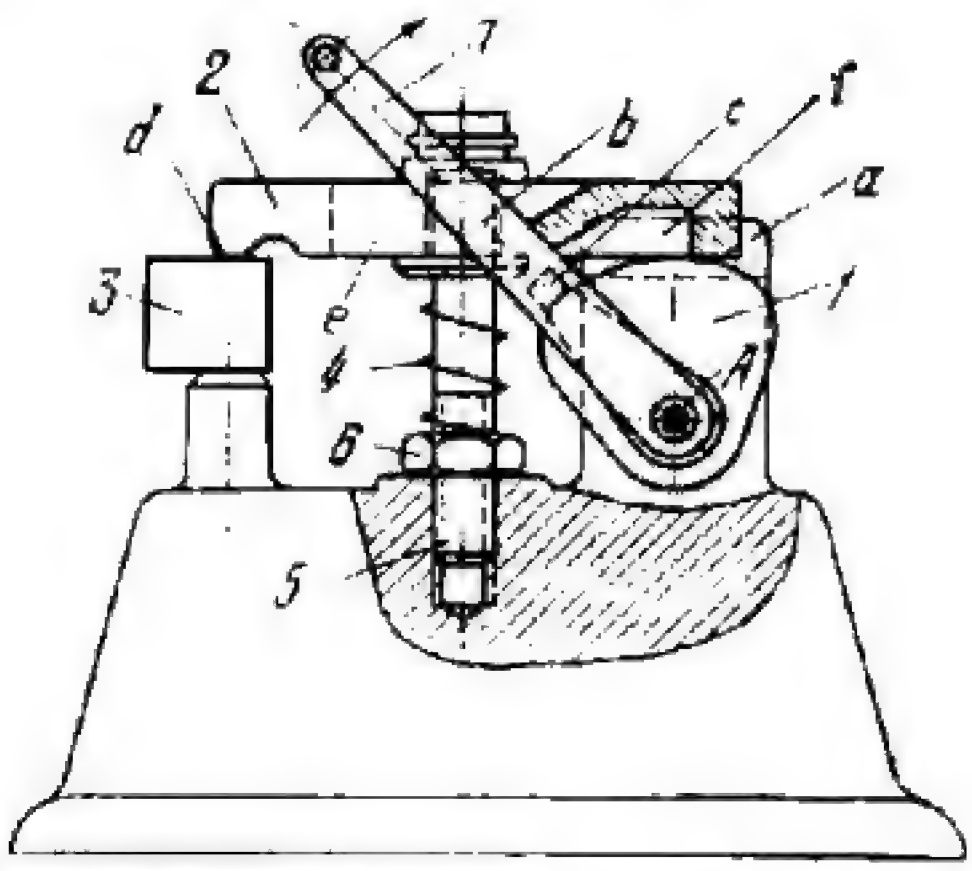
7. GRIPPING, CLAMPING AND EXPANDING MECHANISMS (3224 through 3229)

3224	CAM-LEVER SPATIAL MECHANISM OF A CLAMP	CmL GC



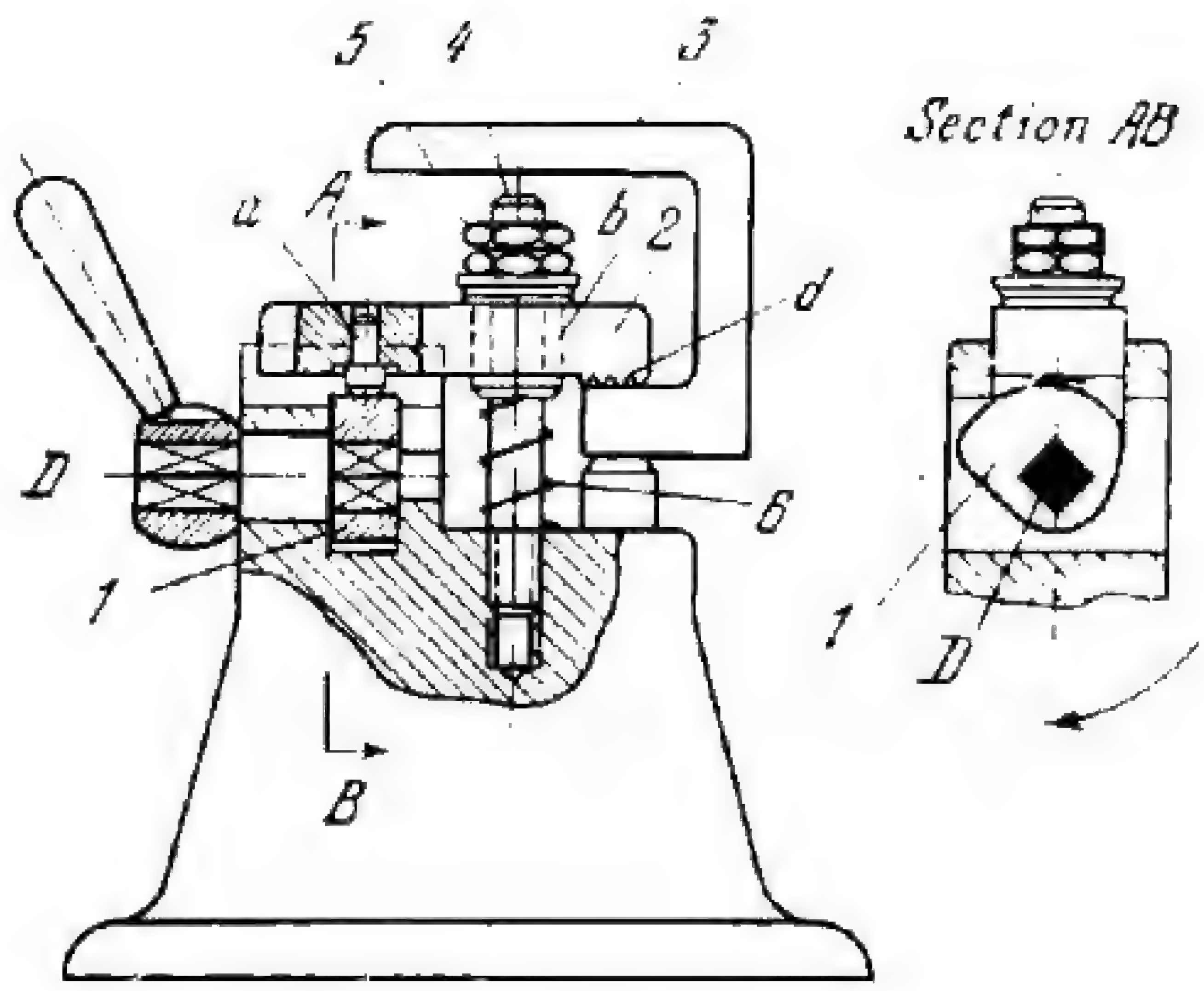
End cam *1*, designed as a slanted washer, turns about fixed axis *A*. Lever (clamp) *2* turns about fixed axis *B* and its surface *a* slides along the working surface of cam *1*. When cam *1* is turned counterclockwise, projection *b* of lever *2* clamps workpiece *3*.

3225	CAM-LEVER MECHANISM OF A RAPID-ACTION CLAMP	CmL GC



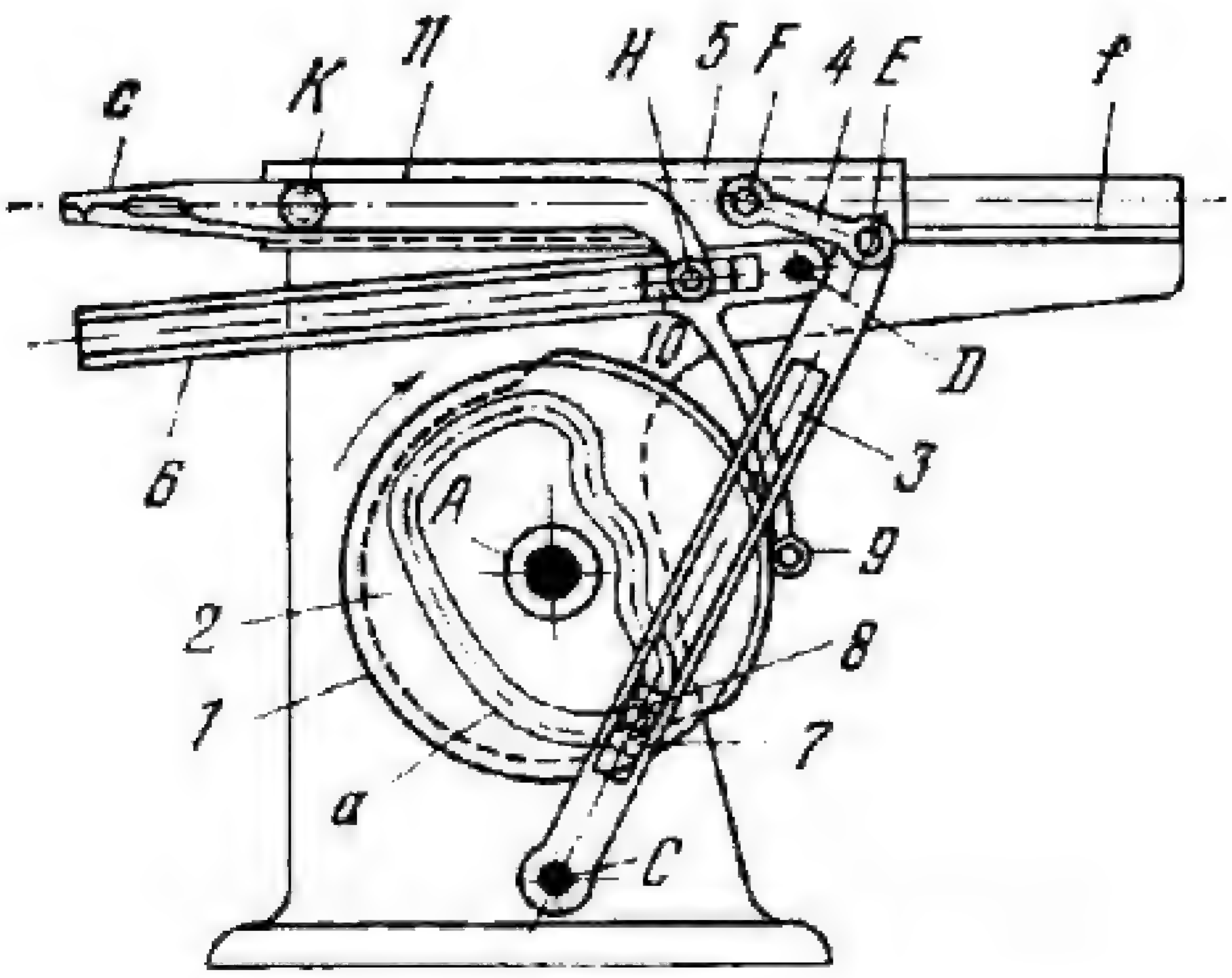
Strap clamp *2* has slot *e* which slides along upper part *b* of bolt *5*, slot *f* for rapid withdrawal and pad *d* for clamping the workpiece. Cam *1* turns about fixed axis *A* and is rigidly attached to handle *7* and to lug *c*. The working surface of cam *1* slides along flat lower face *a* of clamp *2*. To clamp workpiece *3*, clamp *2* is pushed forward and lever *7* is turned counterclockwise. To release the workpiece, handle *7* is turned clockwise. Lug *c* engages slot *f* of clamp *2* and withdraws the clamp to the right. Spring *4* holds clamp up against the head of bolt *5* so that it clears workpiece *3* when unclamped. The height of clamp *2* can be adjusted by bolt *5* which is then locked in the required position by nut *6*.

3226	CAM-LEVER MECHANISM OF A RAPID-ACTION CLAMP	CmL GC

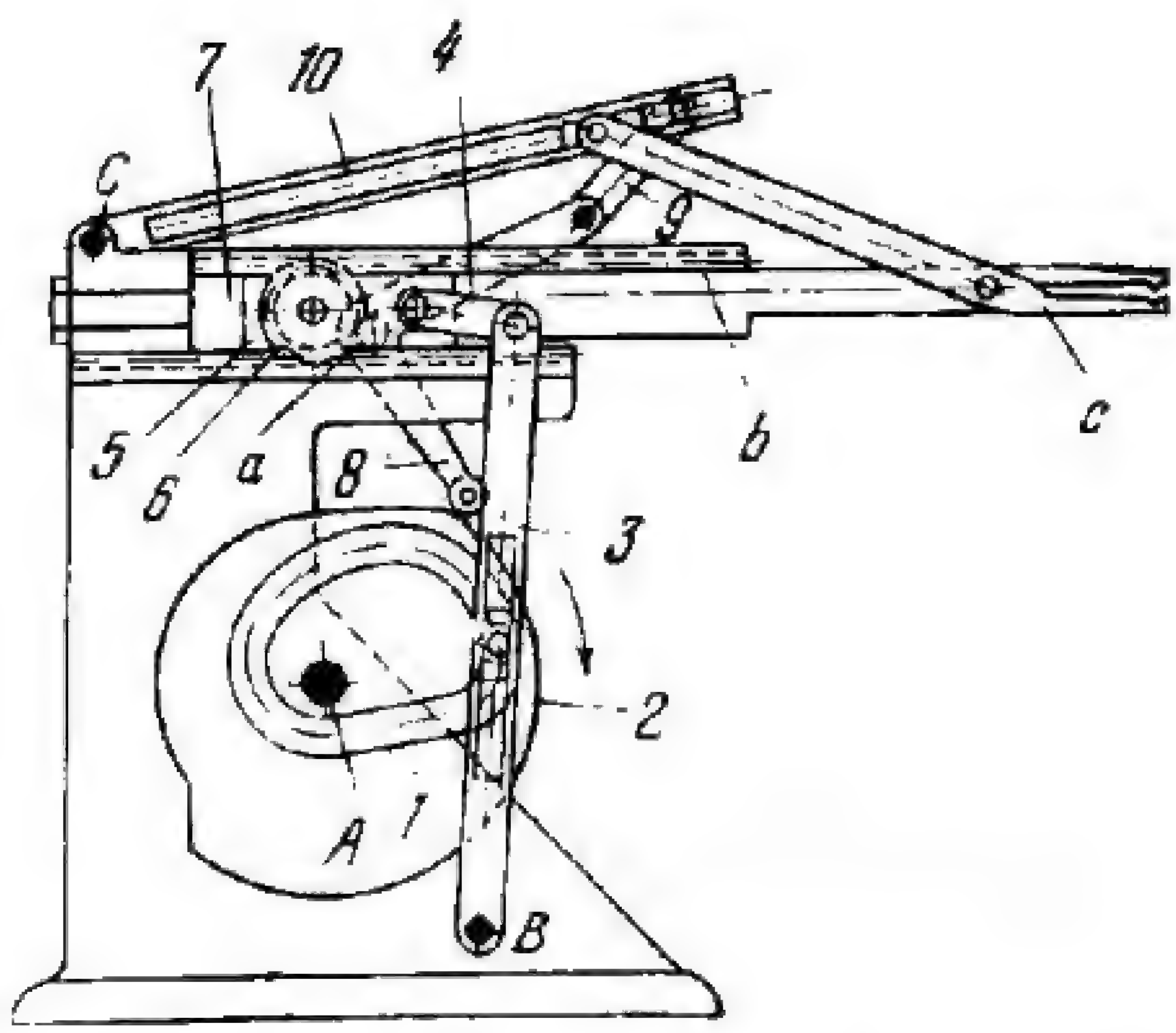


Cam 1 rotates about fixed axis D and its working surface slides along button a of strap clamp 2. Stud 4 passes through elongated hole b in clamp 2 with some clearance. The height of clamp 2 can be adjusted by lock-nuts 5. Spring 6 holds clamp 2 in its upper position against lock-nuts 5 so that it clears workpiece 3 when unclamped. To clamp workpiece 3, clamp 2 is pushed forward and cam 1 is turned clockwise. This clamps the workpiece with serrated pad d of the clamp. To release the workpiece, cam 1 is turned counterclockwise and clamp 2 is withdrawn to the left.

3227	CAM-LEVER PRESS-UNLOADING MECHANISM	CmL GC



Rigidly attached cams 1 and 2 rotate about fixed axis A. Face cam 1 has profiled groove a along which roller 8 of slider 7 rolls and slides. Slider 7 reciprocates along the slot of slotted link 3 which oscillates about fixed axis C. Slotted link 6 oscillates about fixed axis D and carries roller 9 which rolls along the working surface of plate cam 2. Link 4 is connected by turning pairs E and F to slotted link 3 and to slide 5 which reciprocates along fixed guide f. Link 11 has grip c and is connected by turning pairs K and H to slide 5 and to slider 10 which reciprocates along the slot of slotted link 6. When cams 1 and 2 rotate, grip c advances into the die area, grips the workpiece, withdraws it from the die area, and then releases it.



Rigidly attached (or integral) cams *1* and *2* rotate about fixed axis *A*. Slotted lever *3* oscillates about fixed axis *B* and has a slider with a roller that rolls and slides along the groove of face cam *1*. Cam *1*, through lever *3*, link *4*, slide *5*, rack pinion *6* (mounted on slide *5*), fixed rack *a* and reciprocating rack *b* (attached to slide *7*), imparts reciprocating motion to grip *c*. Plate cam *2*, through bellcrank lever *8*, link *9* and slotted link *10* (oscillating about fixed axis *C*), opens and closes grip *c*. When cams *1* and *2* rotate, grip *c* advances into the die area, grips the workpiece, withdraws it from the die area, and then releases it.

3229	**CAM-LEVER MECHANISM OF A DOUBLE CLAMP**	CmL GC

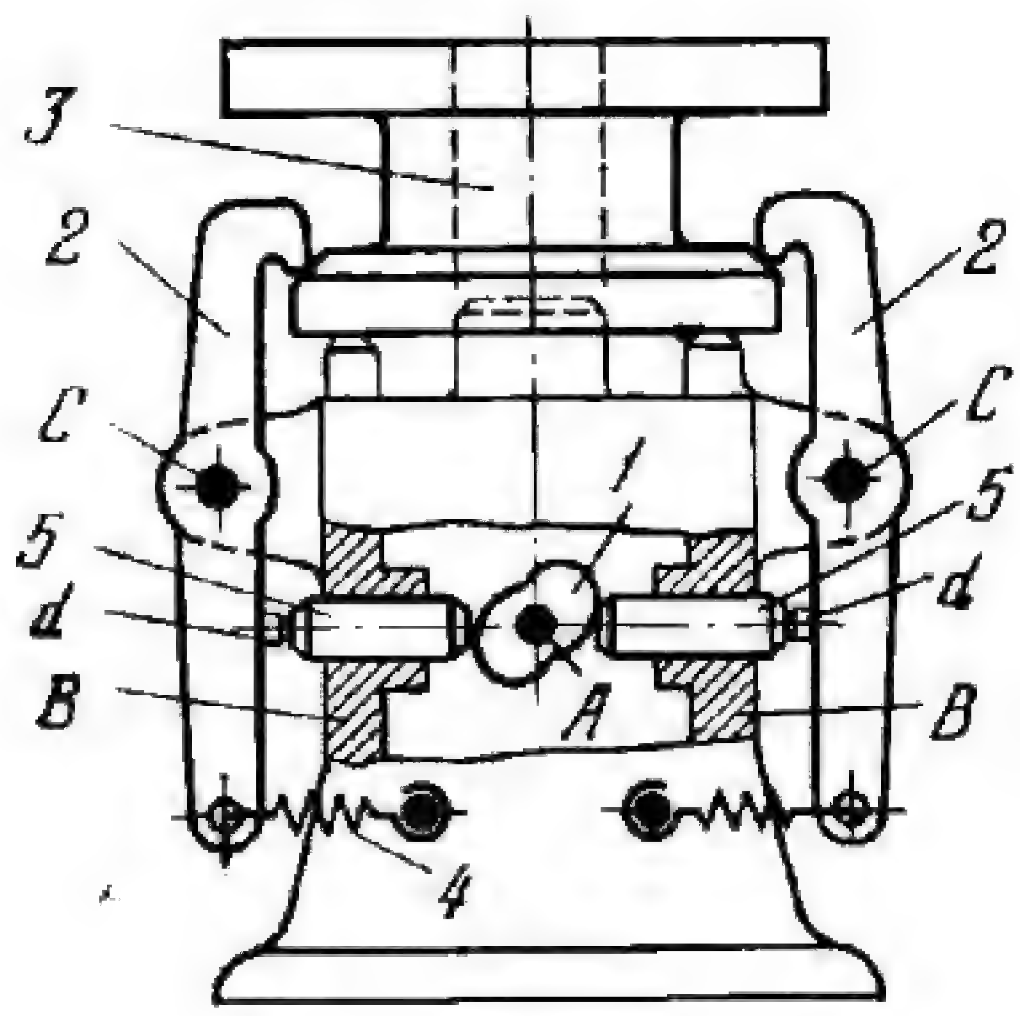
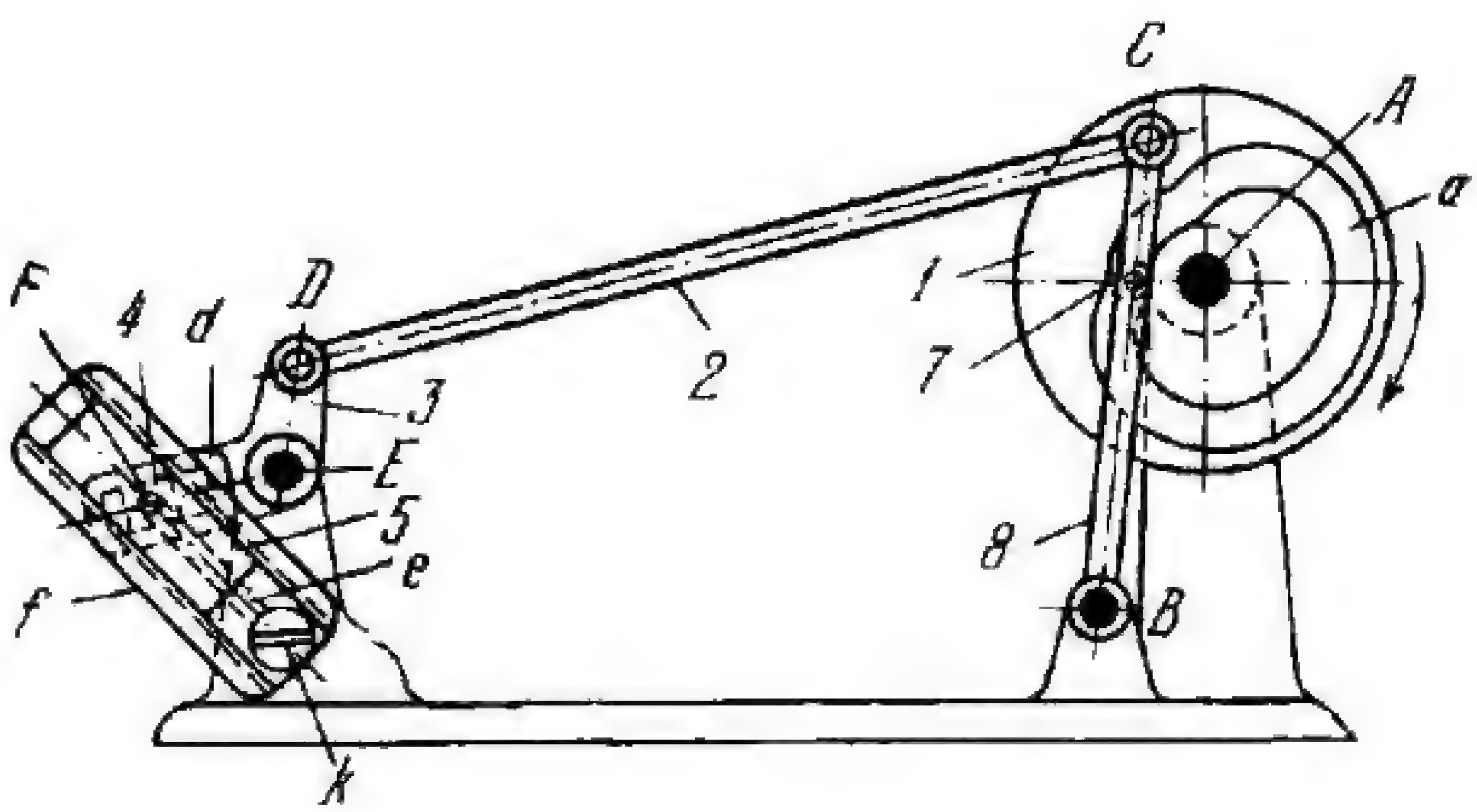


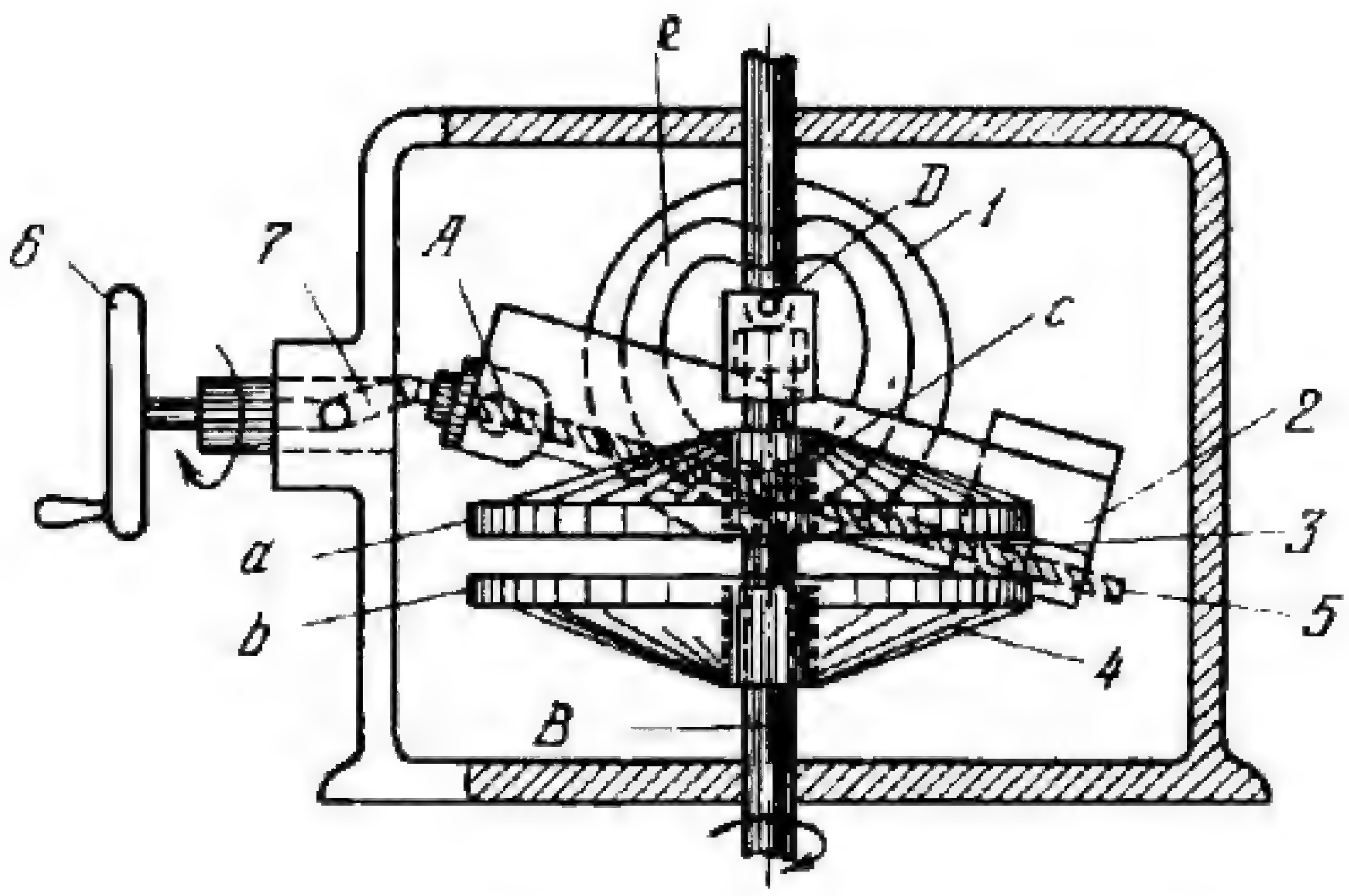
Plate cam *1* turns about fixed axis *A* and acts on symmetrically located pins (followers) *5* which slide in fixed guides *B*. When cam *1* is turned clockwise, pins *5* push against buttons *d* of hinged clamps *2*, turning the clamps about fixed axes *C* to clamp workpiece *3*. To release the workpiece, cam *1* is turned counterclockwise, after which springs *4* return clamps *2* to the initial unclamped position.

3230	CAM-LEVER VARIABLE-STROKE MECHANISM	CmL LL



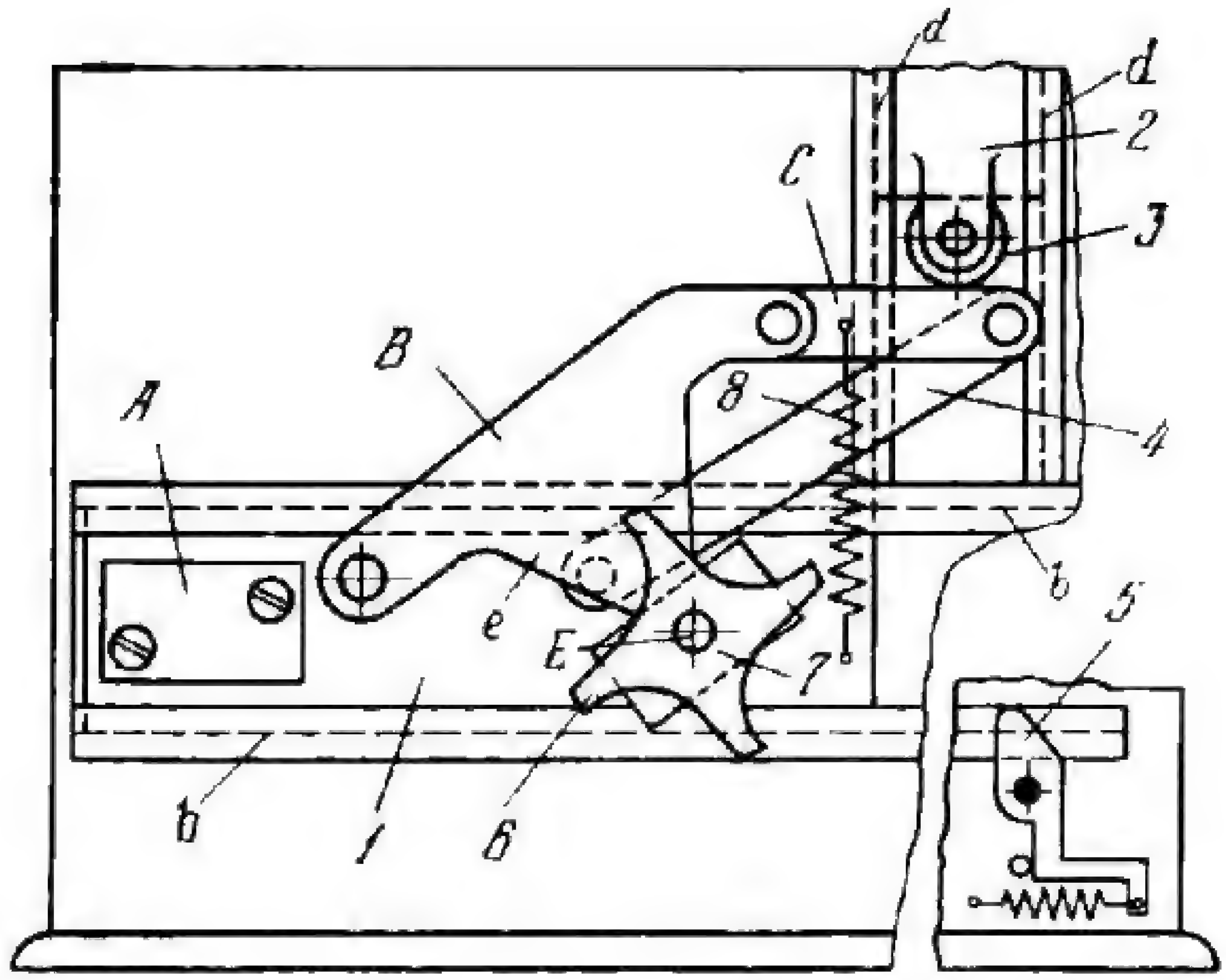
Face cam *1* rotates about fixed axis *A* and has profiled groove *a*. Follower *8* oscillates about fixed axis *B* and carries roller *7* which rolls and slides along groove *a*. Link *2* is connected by turning pairs *C* and *D* to follower *8* and to bellcrank lever *3* which oscillates about fixed axis *E* and has slot *d*. Pin *4* slides along slot *d* and is connected by turning pair *F* to slide *5* which reciprocates along fixed guide *f*. Guide *f* can be set in various positions and clamped as required by screw *k* which passes through slot *e* in the guide. The stroke of the driven member, slide *5*, can be varied by changing the position of guide *f*.

3231	CAM-LEVER VARIABLE-STROKE MECHANISM	CmL LL



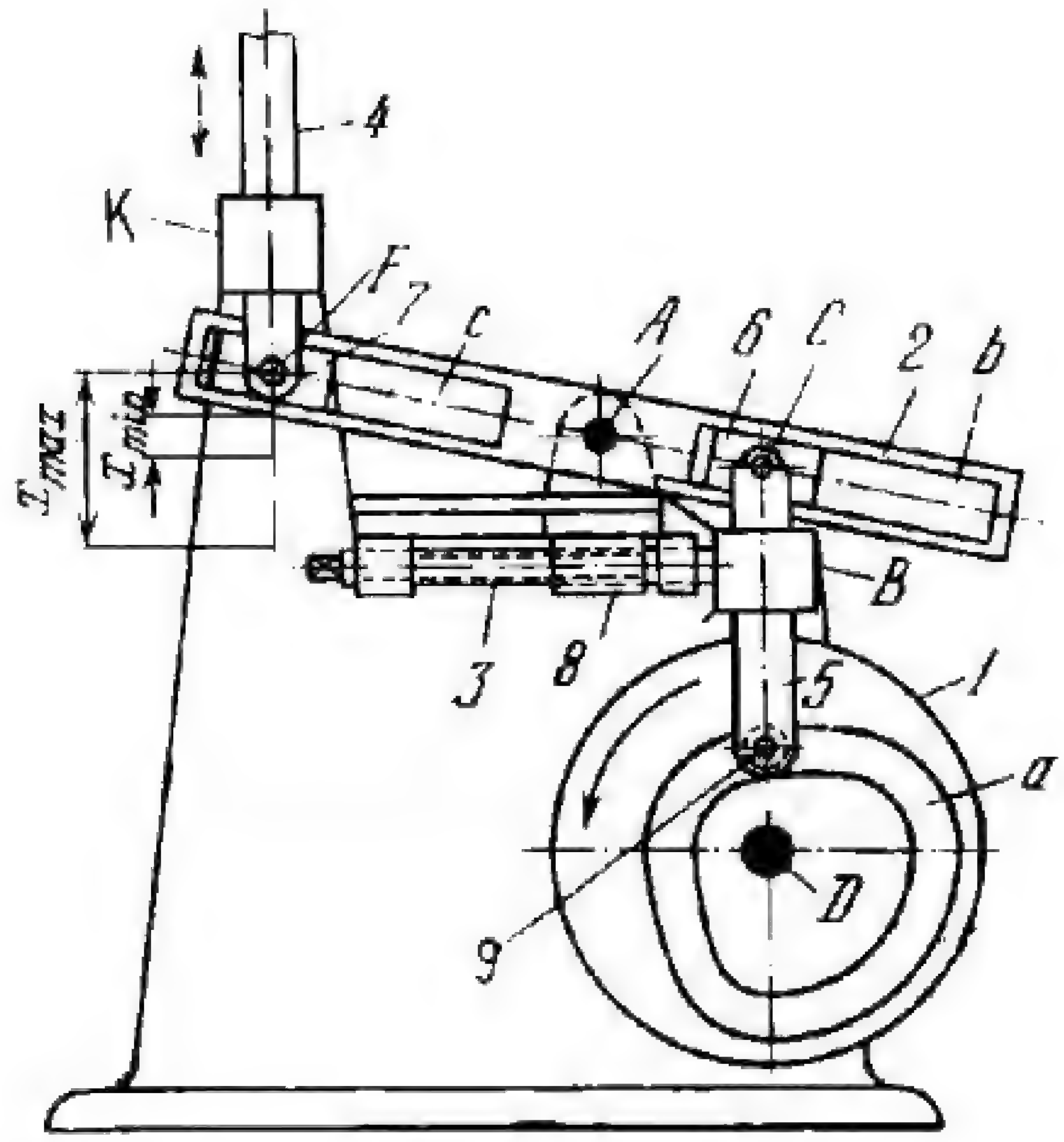
Face cam *1* rotates about fixed axis *D* and has profiled groove *e*. Follower *2* oscillates about fixed axis *A* and carries roller *c* which rolls and slides along groove *e*. Ball *3*, mounted on follower *2*, imparts a supplementary reciprocating axial motion to link *4* and shaft *B*. Their stroke increases with the distance of ball *3* from axis *A*. The position of ball *3* is adjusted by screw *5* which is rotated by handwheel *6* through universal joint *7*. Shaft *B* and link *4* are rotated by a separate mechanism (not shown). Ball *3* is kept in constant contact with link *4* because it is between dish members *a* and *b* of the link.

3232	CAM-LEVER MECHANISM FOR ALTERNATING LONG AND SHORT SLIDE STROKES	CmL LL



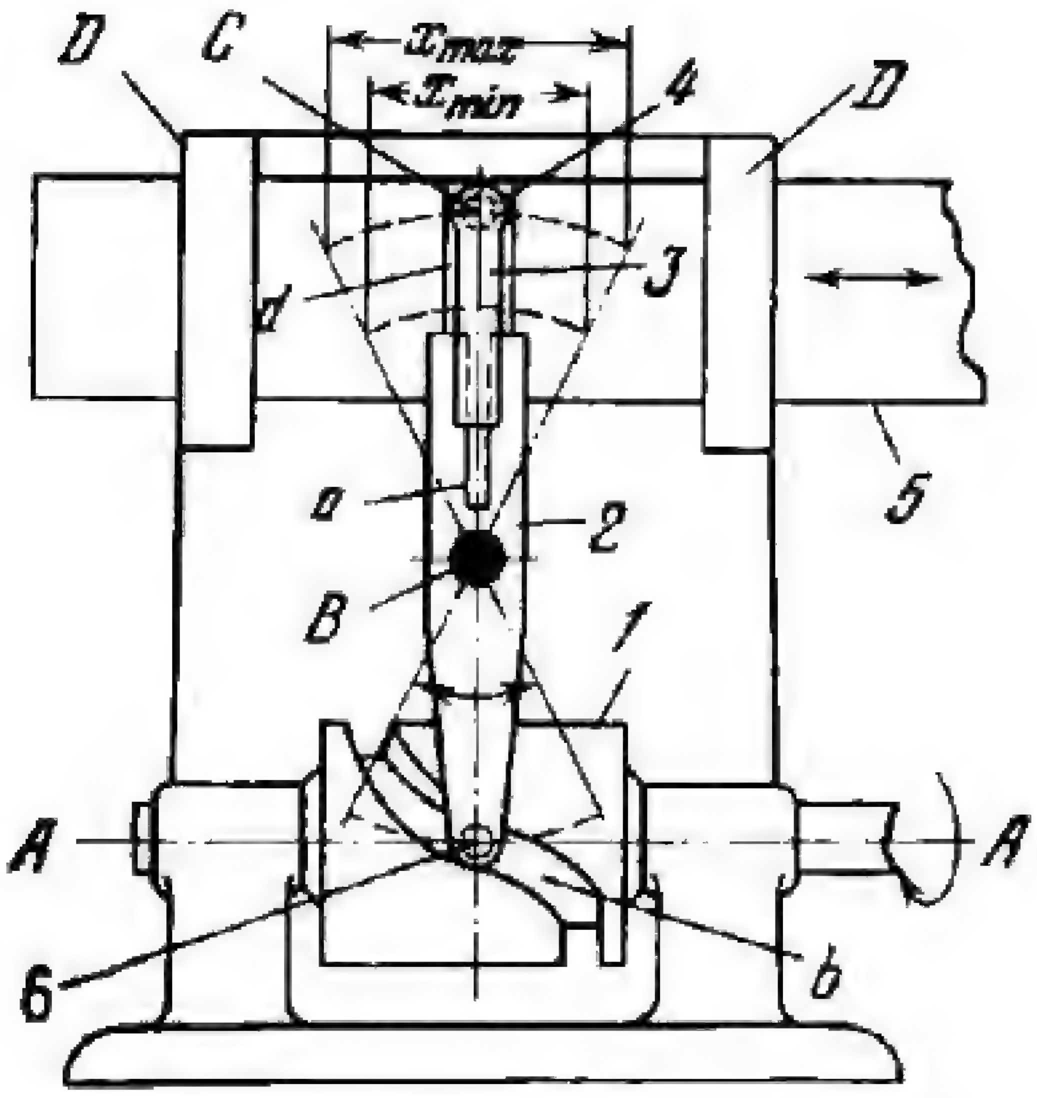
Slide *1* reciprocates along fixed guides *b-b* and carries a cam consisting of block *A*, arm *B* and bar *C* which imparts reciprocating motion to slide *2* along fixed guides *d-d* in a direction perpendicular to the travel of slide *1*. Slide *2* has alternating long and short strokes with dwells at both ends of each stroke while roller *3* of slide *2* rolls along block *A* and bar *C* of the cam. Bar *C* is maintained in its horizontal position on both the long and short strokes of slide *2* by means of link *4* which, together with arm *B* and bar *C*, forms a parallelogram. The stroke of slide *2* is changed every other stroke by changing the angular position of arm *B*. For this purpose, star-wheel *6* is turned by pawl *5* through an angle of 90° on each stroke of slide *1* to the right. Star-wheel *6* is rigidly attached to rectangular block *7* which it turns freely on axis *E* of slide *1*. Lug *e* of arm *B* rests consecutively on the sides of block *7* and is held in contact with the block by spring *8*. Each time star-wheel *6* is turned, block *7* turns arm *B* which then bears against a different side of the block.

3233	CAM-LEVER VARIABLE-STROKE MECHANISM	CmL LL



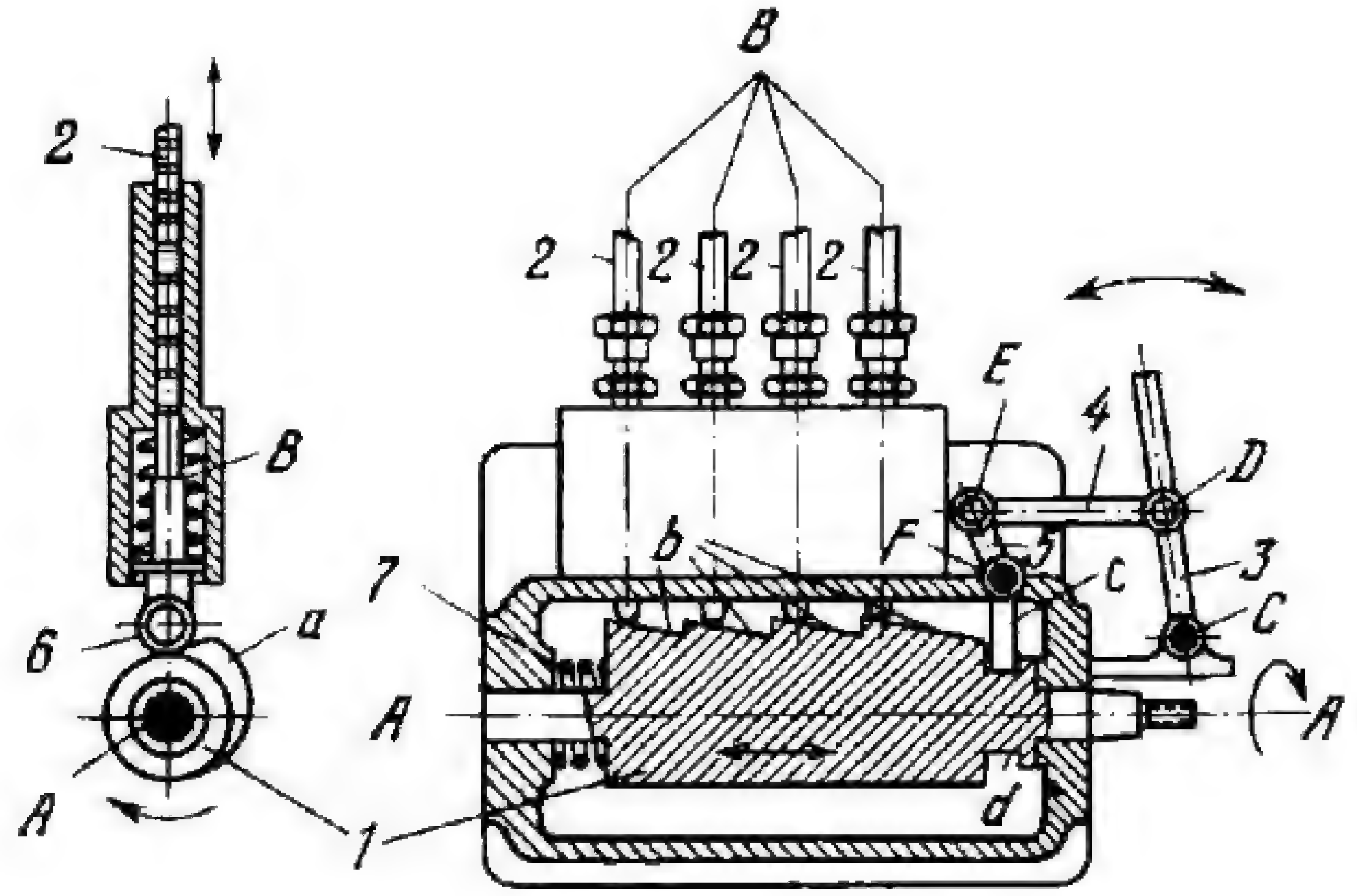
Face cam *1* rotates about fixed axis D and has profiled groove a. Follower *5* reciprocates in fixed guide B and carries roller *9* which rolls and slides along groove a. Follower *5* is connected by turning pair C to slider *6* which reciprocates in slot b of link *2*. Slider *7* reciprocates in slot c of link *2* which oscillates about fixed axis A. Slider *7* is connected by turning pair F to slide *4* which reciprocates in fixed guide K. Bearing *8* with axis A can be adjusted by screw *3* along the axis of the screw, thereby varying the stroke of slide *4* from x_{min} to x_{max}.

3234	CAM-LEVER SPATIAL VARIABLE-STROKE MECHANISM	CmL LL



Cylinder cam *1* rotates about fixed axis *A-A* and has continuous profiled groove *b*. Follower *2* oscillates about fixed axis *B* and carries roller *6* which rolls and slides along groove *b*. Link *3* can be adjusted along slot *a* of follower *2* and clamped in the required position, thereby varying the length $\overline{BC}$ of the arm of follower *2*. Link *3* carries roller *4* which rolls along slot *d* of slide *5*. Slide *5* reciprocates in fixed guides *D-D* and its stroke can be varied from x_{min} to x_{max} by adjusting link *3* in follower *2*.

3235	CAM-LEVER VARIABLE-STROKE MECHANISM	CmL LL



Cam *1* rotates about fixed axis *A* and has four profiled working surfaces *a* which are tapered to one side, as shown at *b*, down to the base circle of the cam. Four followers *2* reciprocate in fixed guides *B* and carry rollers *6* which roll along working surfaces *a* of cam *1*. Cam *1* can be adjusted along axis *A* and is held in its right-hand position by spring *7*. This adjustment is made by four-bar linkage *CDEF* of which links *3* and *5* turn about fixed axes *C* and *F*, and projection *c* of link *5* engages groove *d* of cam *1*. Connecting rod *4* is connected by turning pairs *D* and *E* to links *3* and *5*. By making the axial adjustment of cam *1* and clamping link *3* in the required position, various lengths of stroke of followers *2* can be obtained.

3236	CAM-LEVER VARIABLE-MOTION MECHANISM	CmL LL

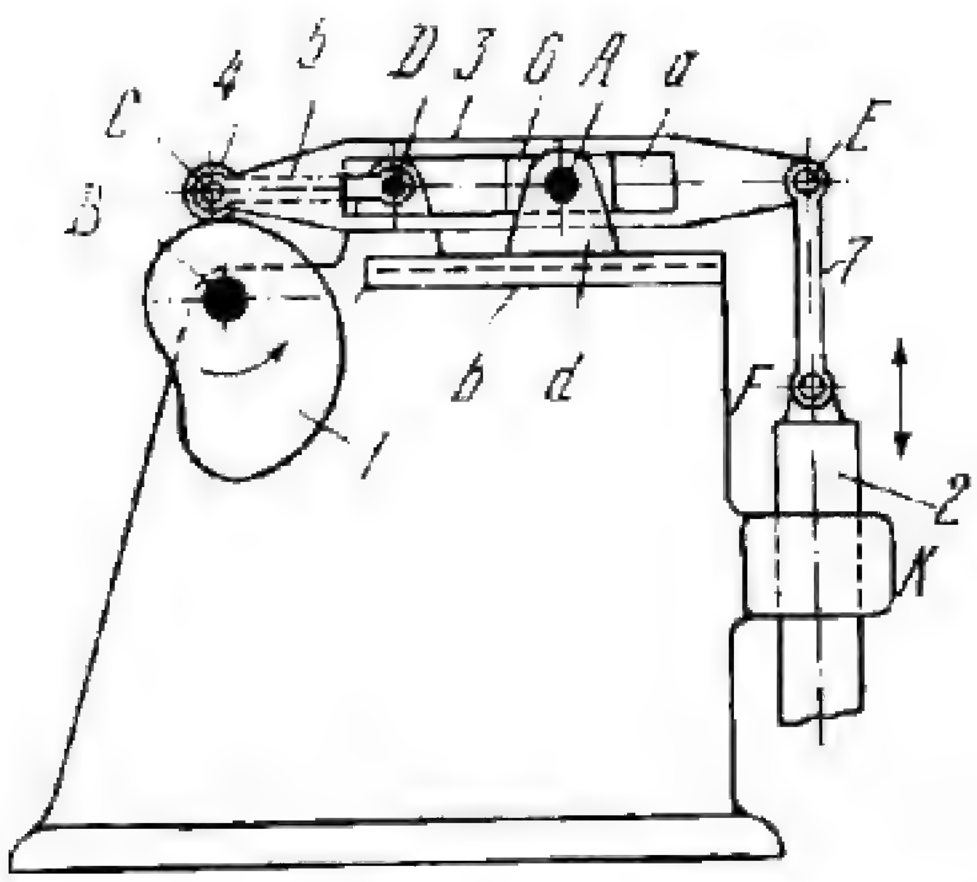


Plate cam *1* rotates about fixed axis *B*. Follower *3* oscillates about fixed axis *A* and carries roller *4* which rolls along the working surface of cam *1*. Link *5* oscillates about fixed axis *D* and is connected by turning pair *C* to follower *3*. Slot *a* of follower *3* slides along slider *6* which oscillates about axis *A*. Link *7* is connected by turning pairs *E* and *F* to follower *3* and to driven slide *2* which reciprocates in fixed guide *K*. Bearing block *d* of slider *6* can be adjusted along guide *b* with respect to axis *D* and clamped in the required position. This adjustment varies the type of motion of slide *2*.

3237	CAM-LEVER VARIABLE-MOTION MECHANISM	CmL LL

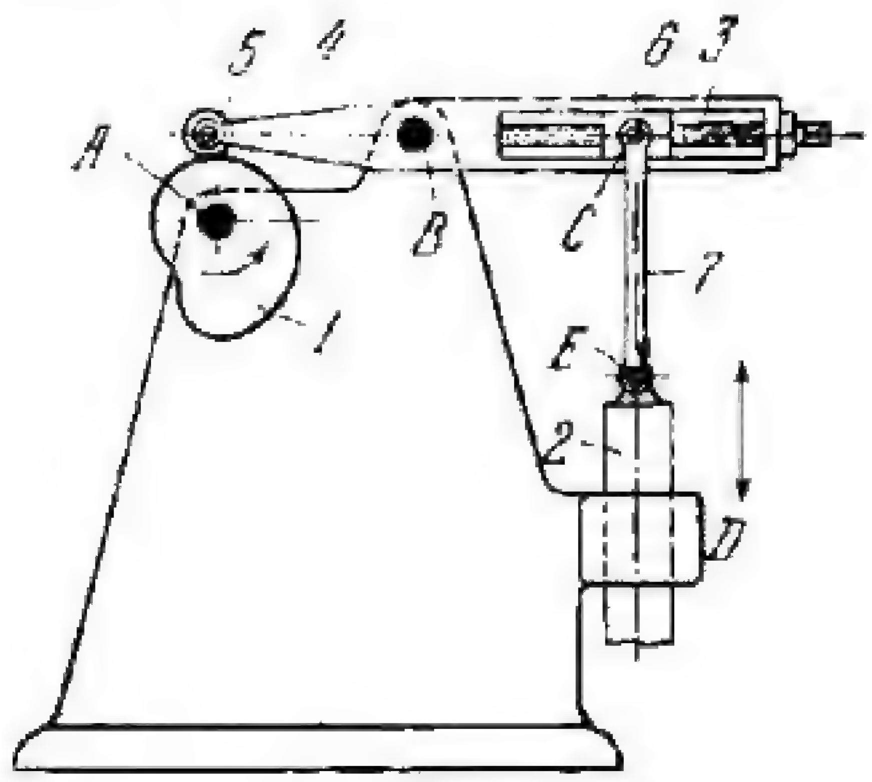


Plate cam *1* rotates about fixed axis *A*. Follower *4* oscillates about fixed axis *B* and carries roller *5* which rolls along the working surface of cam *1*. Follower *4* has screw *3* which is connected by a screw pair to slider *6*. Link *7* is connected by turning pairs *C* and *E* to slider *6* and to driven slide *2* which reciprocates in fixed guide *D*. By means of screw *3*, axis *C* of slider *6* can be adjusted along follower *4* with respect to axis *B* and clamped in the required position, thereby varying the type of motion of slide *2*.

3238	CAM-LEVER VARIABLE-MOTION MECHANISM	CmL LL

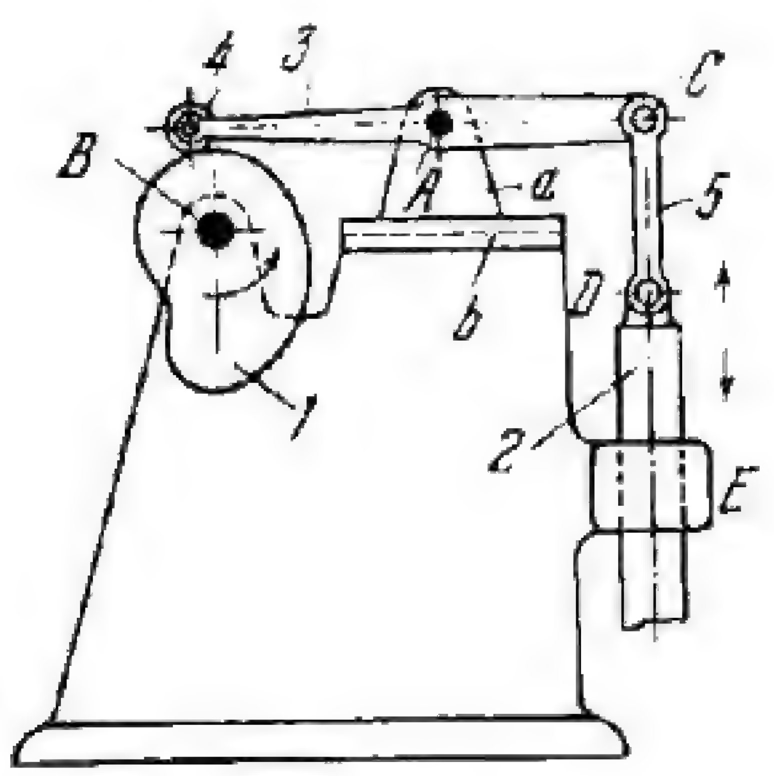
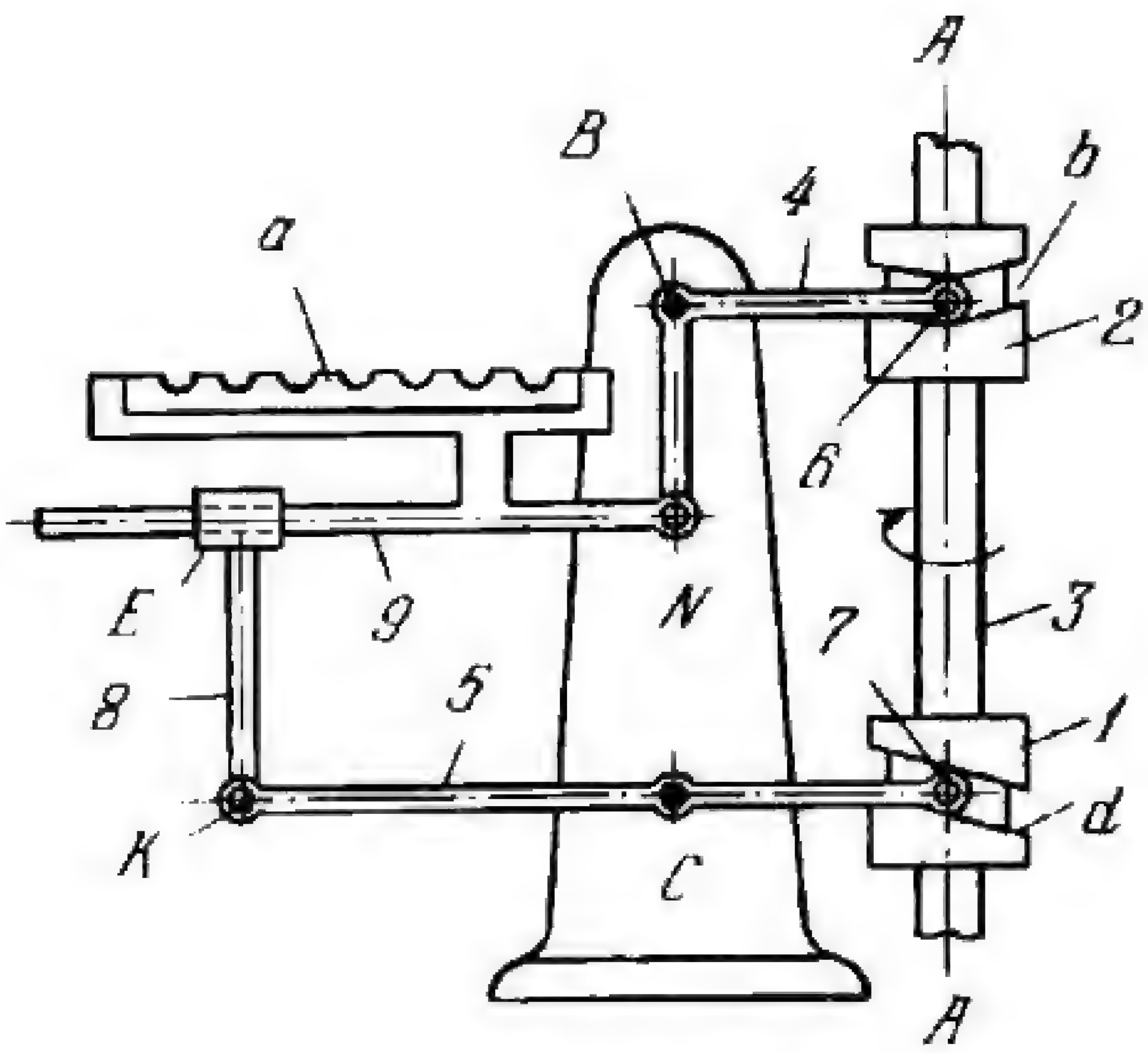


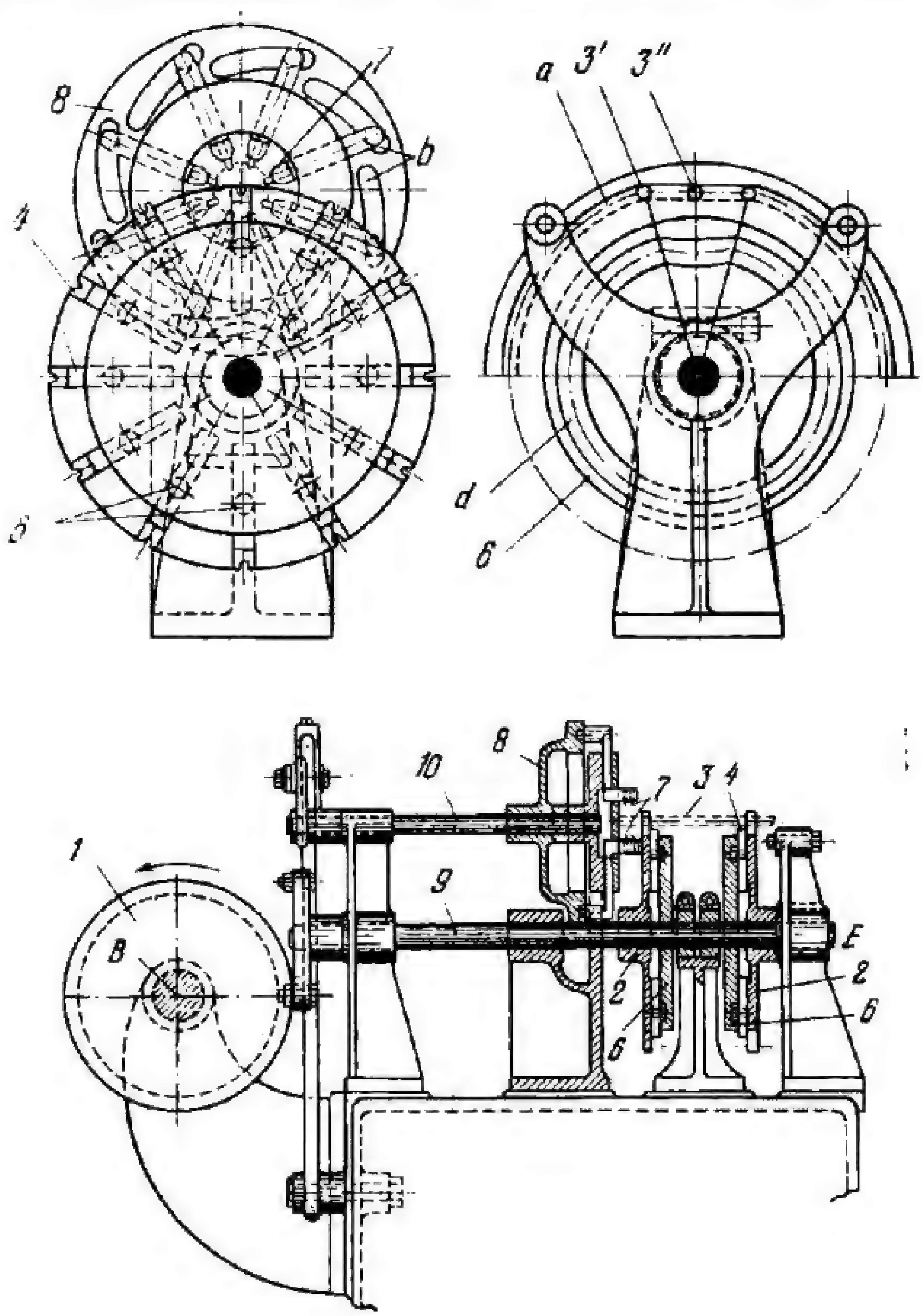
Plate cam *1* rotates about fixed axis *B*. Follower *3* oscillates about fixed axis *A* and carries roller *4* which rolls along the working surface of cam *1*. Link *5* is connected by turning pairs *C* and *D* to follower *3* and to driven slide *2* which reciprocates in fixed guide *E*. Bearing block *a* can be adjusted along guide *b* with respect to axis *B* and clamped in the required position. This adjustment varies the type of motion of slide *2*.

3239	CAM-LEVER SPATIAL FEEDING MECHANISM	CmL SF



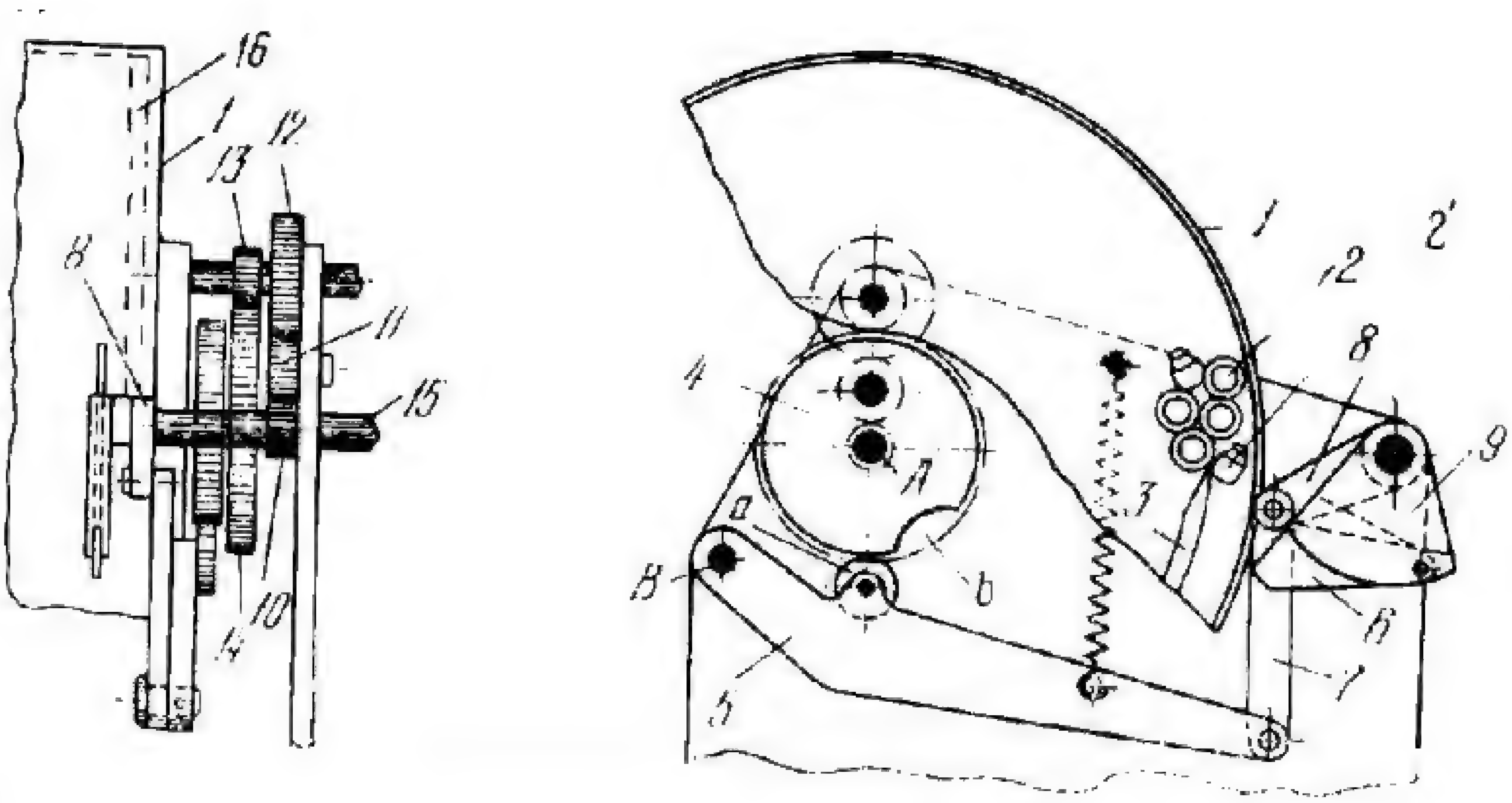
Cylinder cams 1 and 2 are keyed to shaft 3, rotate about fixed axis A-A, and have continuous profiled grooves d and b. Followers 4 and 5 oscillate about fixed axes B and C, and carry rollers 6 and 7 which roll and slide along grooves b and d. Link 8 is connected by turning pair K to follower 5 and by sliding pair E to link 9 which, in turn, is connected by turning pair N to follower 4. By suitably designing the profiles of grooves d and b of cams 1 and 2, the required motion of rack a on link 9 can be obtained for feeding purposes.

3240 | **CAM-LEVER FEEDING AND LAYING-OUT MECHANISM** | CmL SF



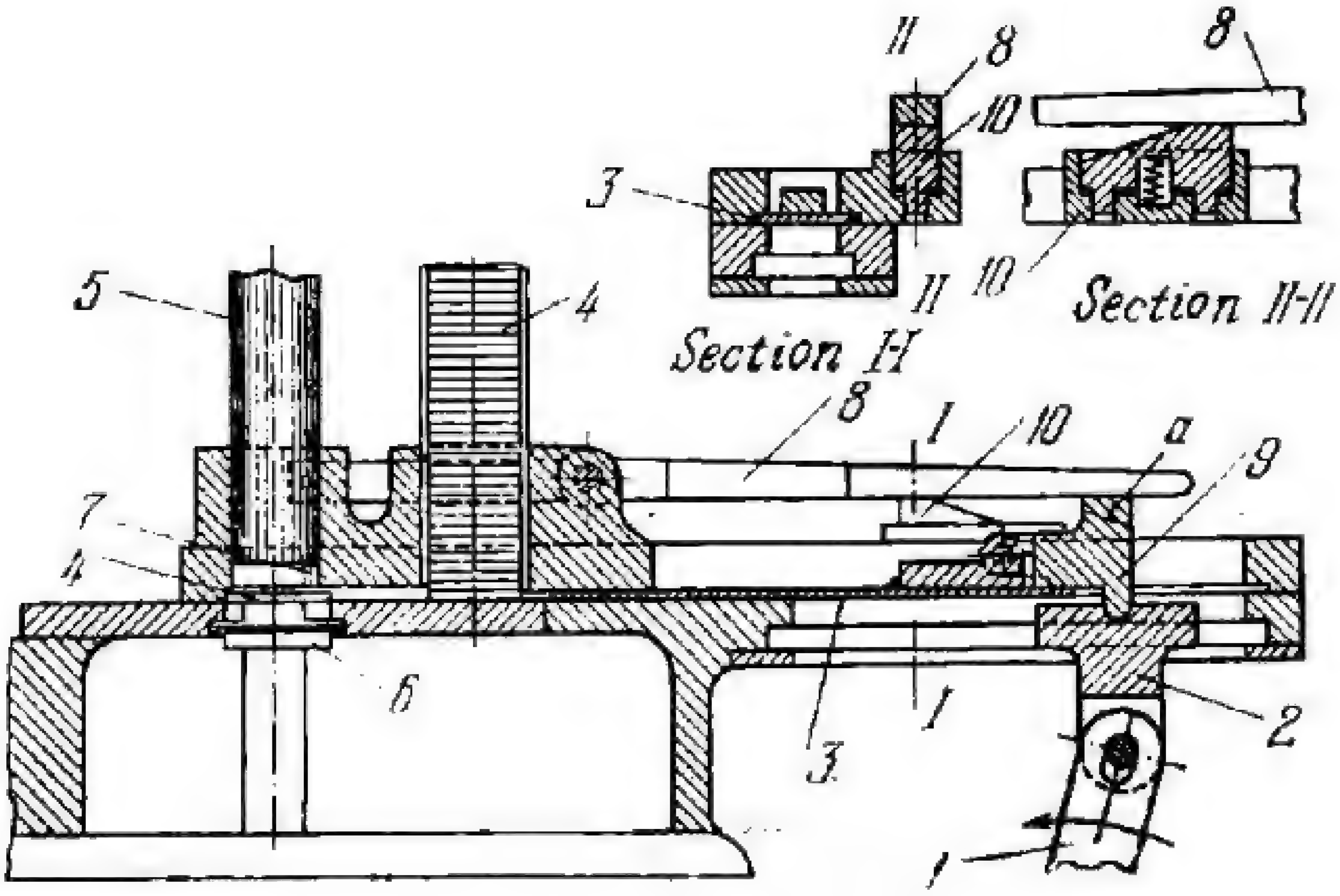
When cylinder cam *1*, whose end view is shown, rotates about fixed axis *B*, it imparts intermittent rotation to shaft *9* about fixed axis *E* and oscillation to shaft *10*, synchronous to the motion of shaft *9*. Disks *2*, keyed to shaft *9*, rotate intermittently, and workpieces *3*, resting in the U-shaped grooves of sliders *4*, are fed to the laying-out station. From considerations of design it is necessary for workpieces *3* to follow path *a*. For this purpose, rollers *5*, mounted on sliders *4*, roll and slide along profiled grooves *d* of fixed disks *6*. As soon as workpiece *3* reaches position *3'*, centre-punches *7* begin to move inward by the action of profiled grooves *b* on their holders. When the workpiece reaches position *3''*, it is centre-punched. After this, disk *8*, keyed to shaft *10*, turns in the opposite direction to retract centre-punches *7* and, after reversal of disk *8*, they are advanced radially again to centre-punch the next workpiece. Thus, disks *2* periodically feed workpieces *3* to be centre-punched.

3241	CAM-LEVER HOPPER FEED MECHANISM	CmL SF



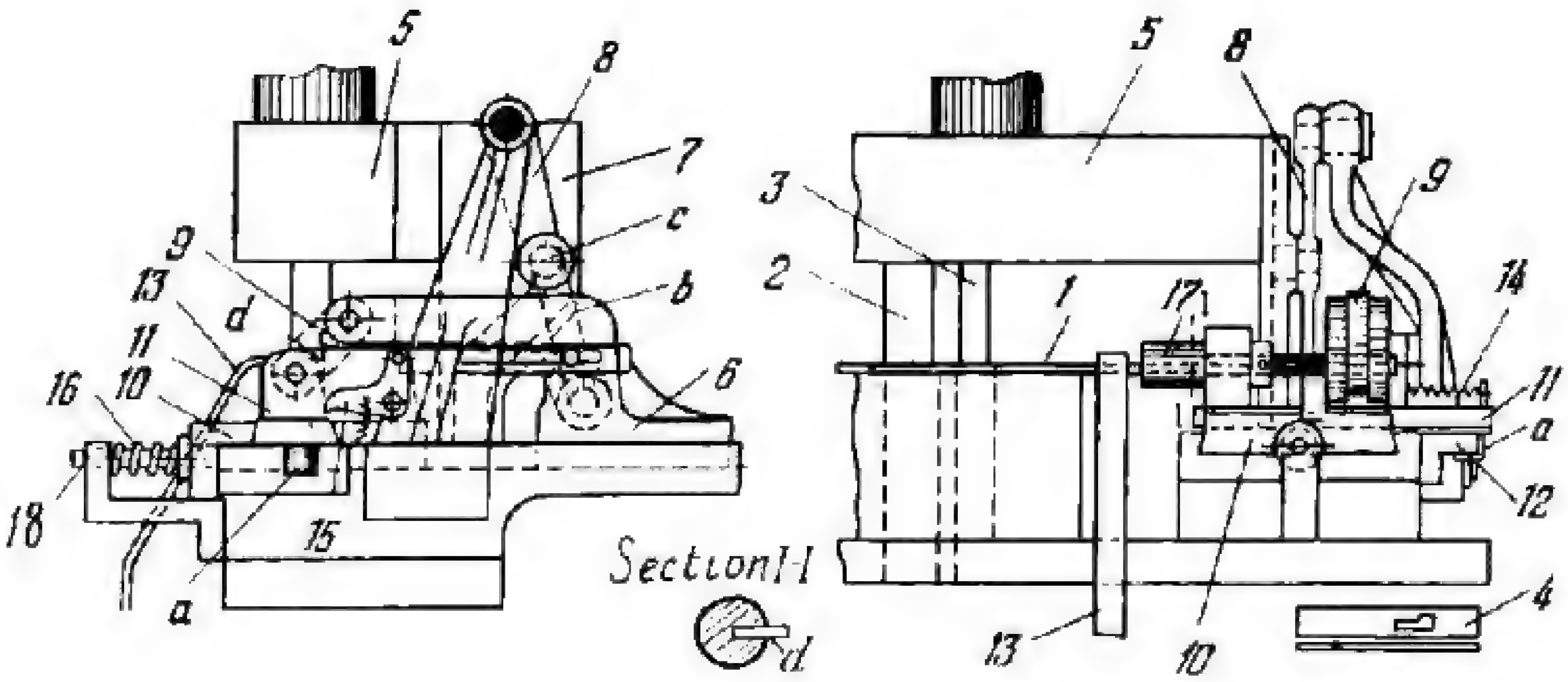
Flat disk *16* is keyed to drive shaft *15* and rotates about fixed axis *A* in hopper feed housing *1*, carrying blanks *2* toward fixed aligning strip *3* which lines up the blanks in the required position as they leave the hopper to slide down a chute into a press. Improperly positioned blanks, as at 2′, may clog or jam the hopper exit. This is prevented in the following manner. Cam *4* is driven from shaft *15* through gears *10*, *11*, *12*, *13* and *14*, and has a circular cut-out portion *b*. Follower *5* turns about fixed axis *B* and carries roller *a* which periodically drops into cut-out portion *b*. As a result, a sweeping motion is transmitted to link *6* through links *7*, *8* and *9*. Link *6*, rigidly attached to link *9* and oscillating so that it enters a slit in hopper housing *1*, sweeps away or dislodges incorrectly positioned workpiece *2′*.

3242	CAM-LEVER FEEDING MECHANISM WITH AN AUTOMATIC STOP	CmL SF



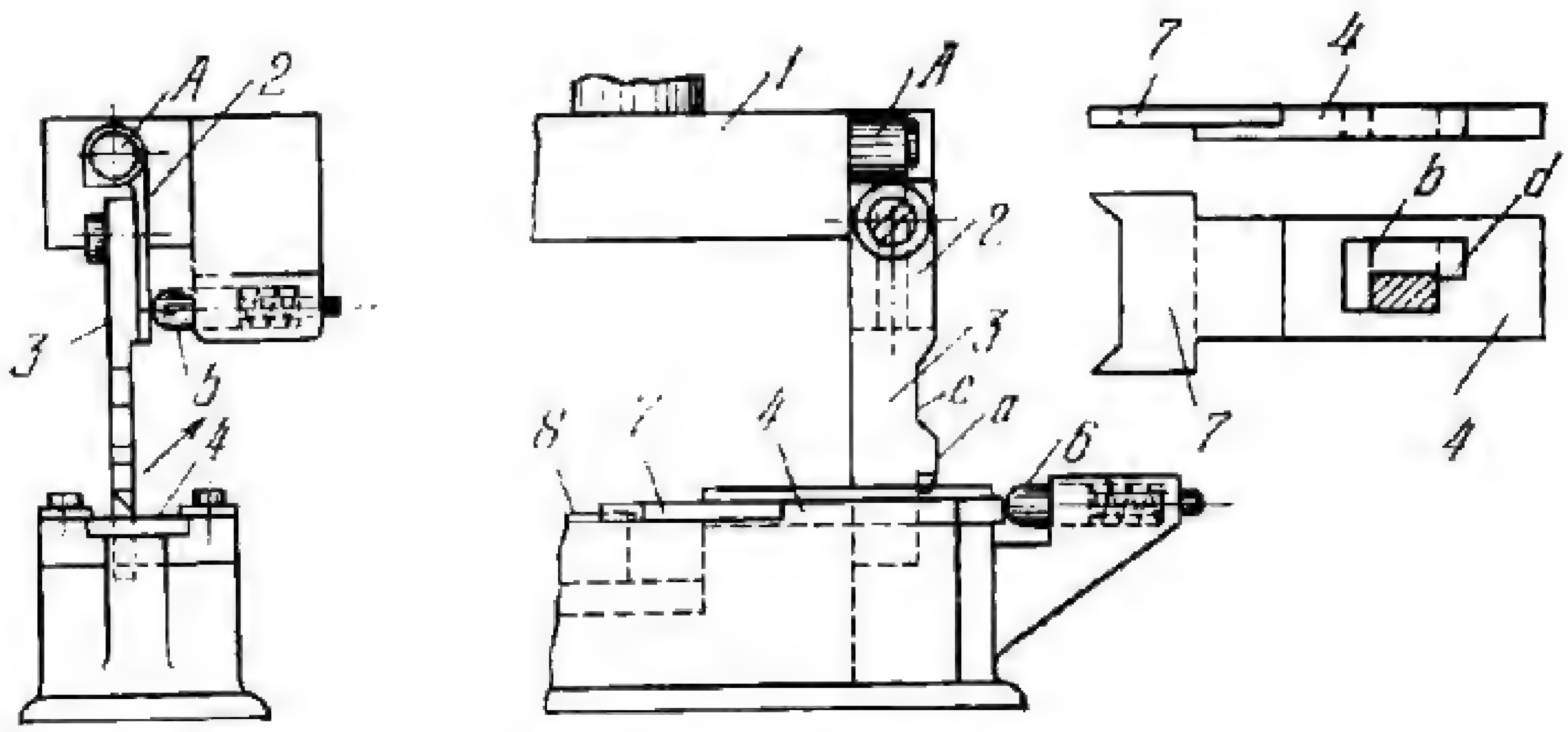
When rocker arm *1* oscillates, driving slide *2* reciprocates together with feeding finger *3*, feeding disks *4*, one by one, under plunger *5*. Synchronized with this disk feeding mechanism is a mechanism for feeding caps *6* into which the disks are forced by plunger *5*. Feeler bar *7*, mounted at one end of lever *8*, checks whether a cap is ready to receive the next disk, controlling the disk feeding mechanism as follows. If there is a cap under feeler bar *7*, lever *8* is in the position shown and when slide *2* travels to the left, latch *9*, hinged to feeding finger *3*, slides along lever *8* and its projection *a* depresses spring-loaded tapered button *10*. At this, a disk *4* is forced by plunger *5* into a cap *6*. When there is no cap under feeler bar *7*, lever *8* turns counterclockwise and latch *9*, when its projection *a* meets tapered button *10*, is turned out of engagement with slide *2* so that the feeding of disks *4* is stopped. Slide *2* reciprocates idly until a new cap is fed under feeler bar *7*. This raises the bar and turns lever *8* clockwise, enabling latch *9* to engage slide *2*, and the feeding of disks *4* begins again.

3243	CAM-LEVER TRANSFER MECHANISM FOR STACKING WORKPIECES	CmL SF

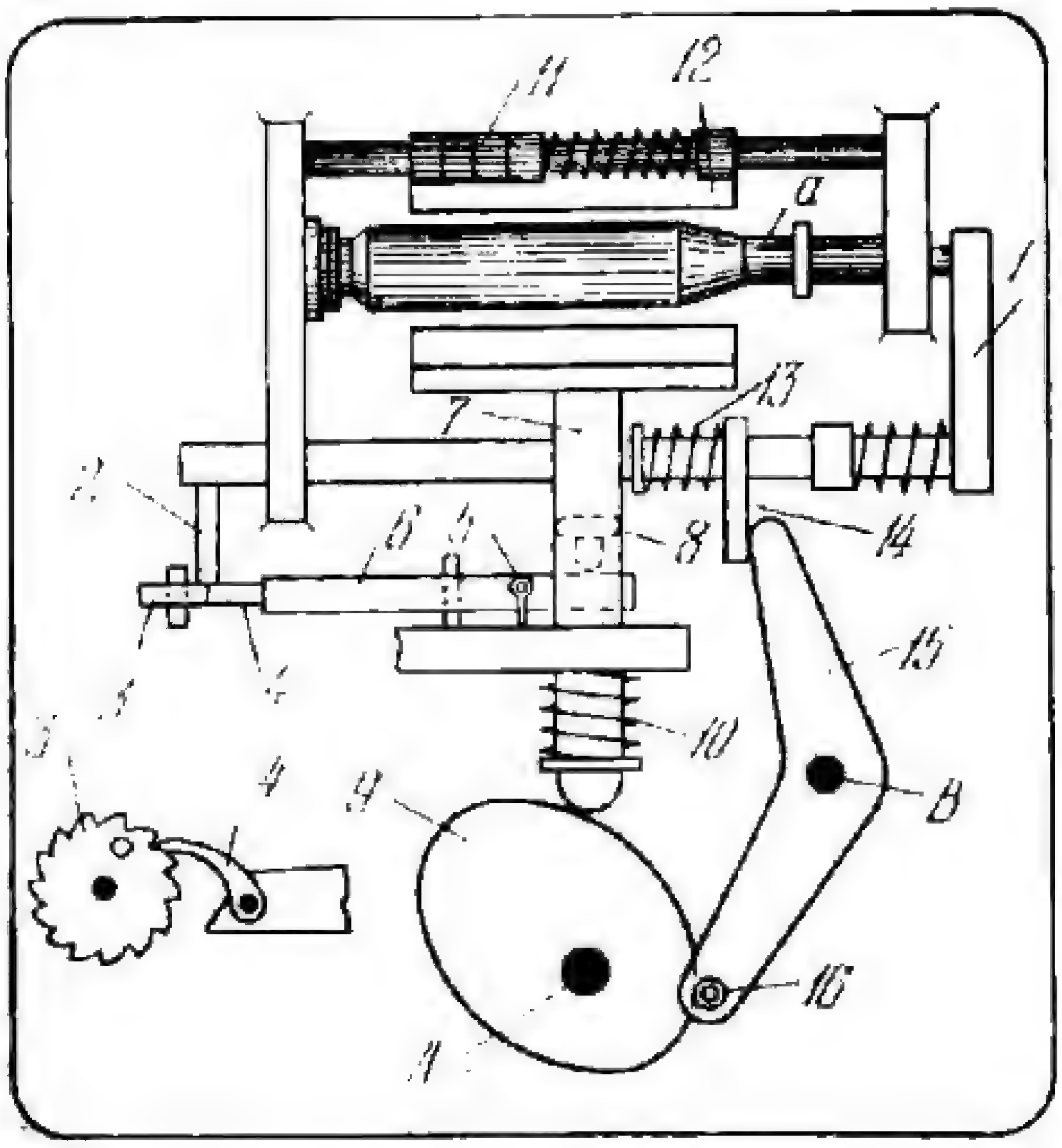


Strip stock *1* is fed to the right so that its end enters recess *d* in shaft *17*. Then punch-holder *5* descends and the stock is pierced by punch *2* and cut off by punch *3*, finished part *4* remaining in recess *d*. As the press ram and punch-holder *5* ascend, cam slot *b* of cam plate *7*, mounted on punch-holder *5*, acts on roller *c* of lever *8*, moving slide *6* to the left. At this, shaft *17*, to which link *9* is keyed, is turned 90° counterclockwise. When the inner edge of slide *6* reaches the inner end of slide *10*, the latter begins to move to the left, compressing spring *16*. In this motion, part *4* is placed over rod *13*. As slide *10* continues moving to the left, roller *a* of cross-slide *11* engages fixed cam *12*, pulling the cross-slide to the right (in the right-hand view) together with shaft *17* which is thus removed from part *4*, allowing it to drop to the bottom of rod *13*. As the ram and punch-holder *5* descend again, cross-slide *11* is returned to its initial position by spring *14* and is locked to slide *10* by spring-actuated latch *15*. Slide *6* is returned to its initial position by the action of cam slot *b* on roller *c* of lever *8*. Slide *10* is returned to its initial position by spring *16* so that the flange of stud *18* contacts the fixed base. Continued motion of slide *6* turns shaft *17*, through link *9*, back to its initial position, ready to receive the next part.

3244	CAM-LEVER DIE MECHANISM FOR SHIFTING A STOP WHILE EJECTING THE WORKPIECE	CmL SF

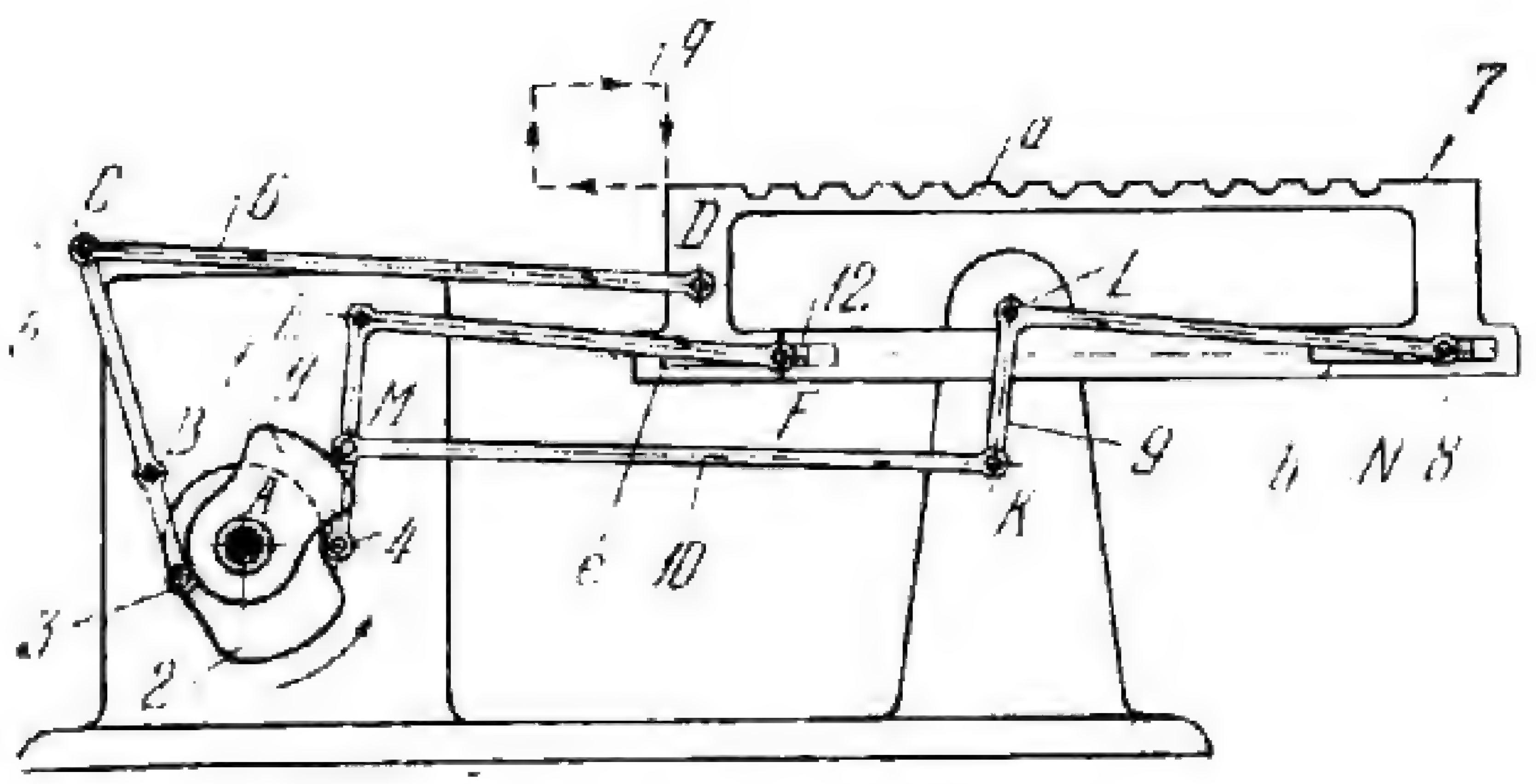


When the press ram with punch-holder *1* descends, hinge *2*, pivoted to the punch-holder, moves downward with its rigidly attached cam-arm *3*. When the angular edge at the bottom of projection *a* of cam-arm *3* engages edge *d* of opening *b* in slide *4*, hinge *2*, together with cam-arm *3*, is turned about pivot *A* in the direction of the arrow, depressing spring-actuated plunger *5*. At this point, cam-arm *3* is in the position shown by dash lines in opening *b*, and slide *4* is stationary. As the ram and punch-holder *1* continue to descend, projection *a* of cam-arm *3* passes the corner at *d*, so that recess *c* allows the cam-arm to be swung back to its normal position (corresponding to the sectional area in opening *b*) by plunger *5*. As the press ram and punch-holder *1* begin to ascend, the angular portion at the top of projection *a* engages the under side at corner *d*, causing slide *4* to move to the right together with workpiece locating stop *7* to which it is rigidly attached. At this moment, the finished part is ejected from the die and a new blank *8* is fed into place by a special feeding device (not shown). As the press ram continues its upward motion, projection *a* leaves slide *4* which is returned by spring-actuated plunger *6* to its position for locating blank *8*. The action of slide *4* can be timed accurately with respect to the ram stroke by adjusting cam-arm *3* to the required position along hinge *2*.



Workpiece a being sorted presses against crosspiece *1* which, by means of pin *2*, turns ratchet wheel *3* through a certain angle depending on the size of workpiece a. Due to the action of spring *5*, pawl *4* slides off a tooth of wheel *3* and, when crosspiece *1* is shifted to the side, releasing workpiece a, the positions of ratchet wheel *3* and pawl *4* turn out to be set in accordance with the size of workpiece a. If the size is within the specified tolerances, pawl *4* remains on the middle tooth of wheel *3* and the rear end of lever *6* does not engage plunger *7*. Then, as cam *9* rotates about fixed axis A, plunger *7*, held in contact with cam *9* by spring *10*, is retracted, and workpiece a drops into the within-size box. If workpiece a is off-size, then pawl *4* remains on one of the extreme teeth of ratchet wheel *3*, lever *6* engages plunger *7* by dropping into recess *8*, plunger *7* is not retracted and the workpiece does not drop into the within-size box. As cam *9* continues to rotate, the workpiece is pushed beyond spring-actuated shutter *11* into the reject box. Crosspiece *1* is held in contact with the workpiece by spring *13* and follower *15* which oscillates about fixed axis B and carries roller *16* rolling along the working surface of cam *9*.

3246 | CAM-LEVER TRANSFER FEEDING MECHANISM | CmL SF



Rigidly attached plate cams *1* and *2* rotate about fixed axis A. Follower *5* oscillates about fixed axis B and carries roller *3* which rolls along the working surface of cam *1*. Follower *11* oscillates about fixed axis E and carries roller *4* which rolls along the working surface of cam *2*. Link *6* is connected by turning pairs C and D to follower *5* and to transfer member *7* with rack a. Link *10* is connected by turning pairs M and K to follower *11* and to bellcrank lever *9* which oscillates about fixed axis L. Links *11* and *9* are connected by turning pairs F and N to sliders *12* and *8* which move along guides e and b of member *7*. The lengths of the links comply with the conditions: $\overline{EF} = \overline{LN}$, $\overline{ME} = \overline{KL}$ and $\overline{MK} = \overline{EL}$. When cams *1* and *2* rotate, rack a has a translational motion along closed rectangular path q, remaining parallel to its initial position. This is achieved by proper design of cams *1* and *2*.

3247	CAM-LEVER FEEDING MECHANISM FOR CYLINDRICAL BLANKS	CmL SF

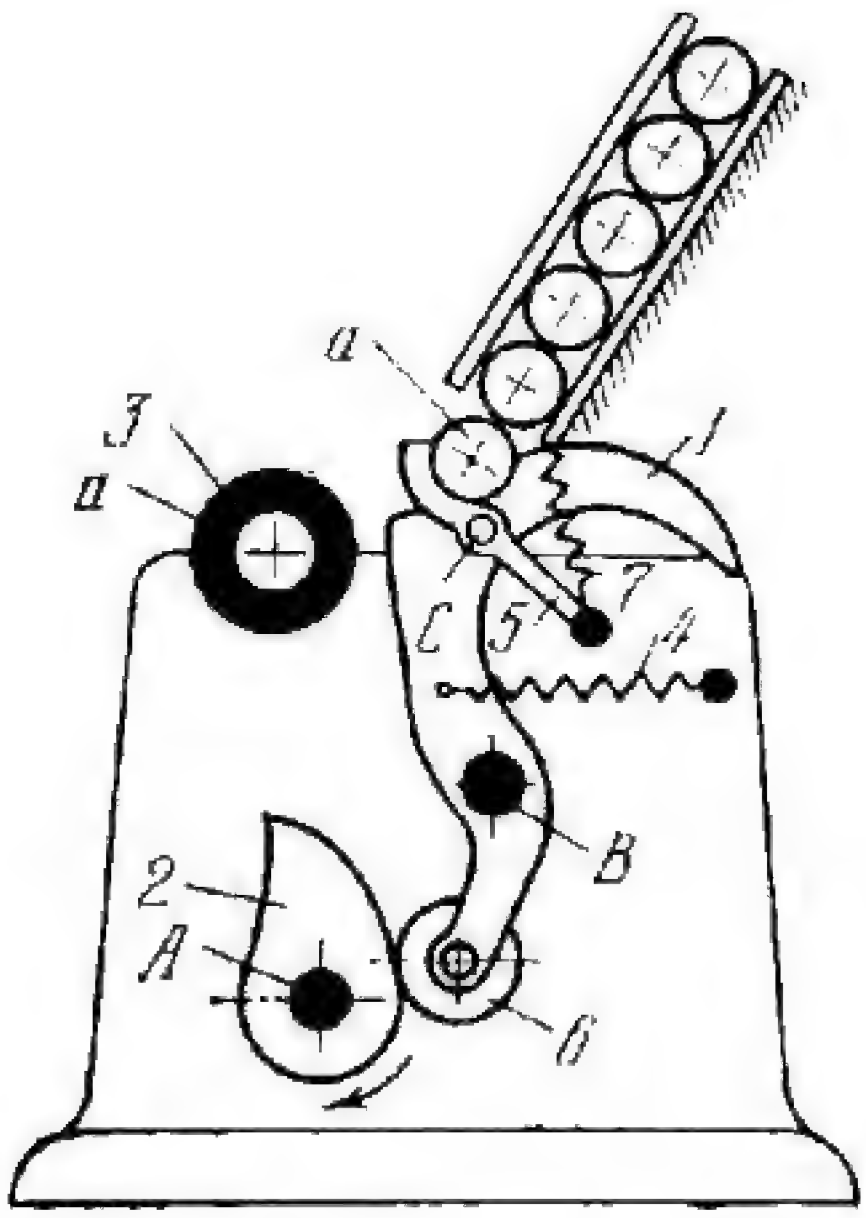
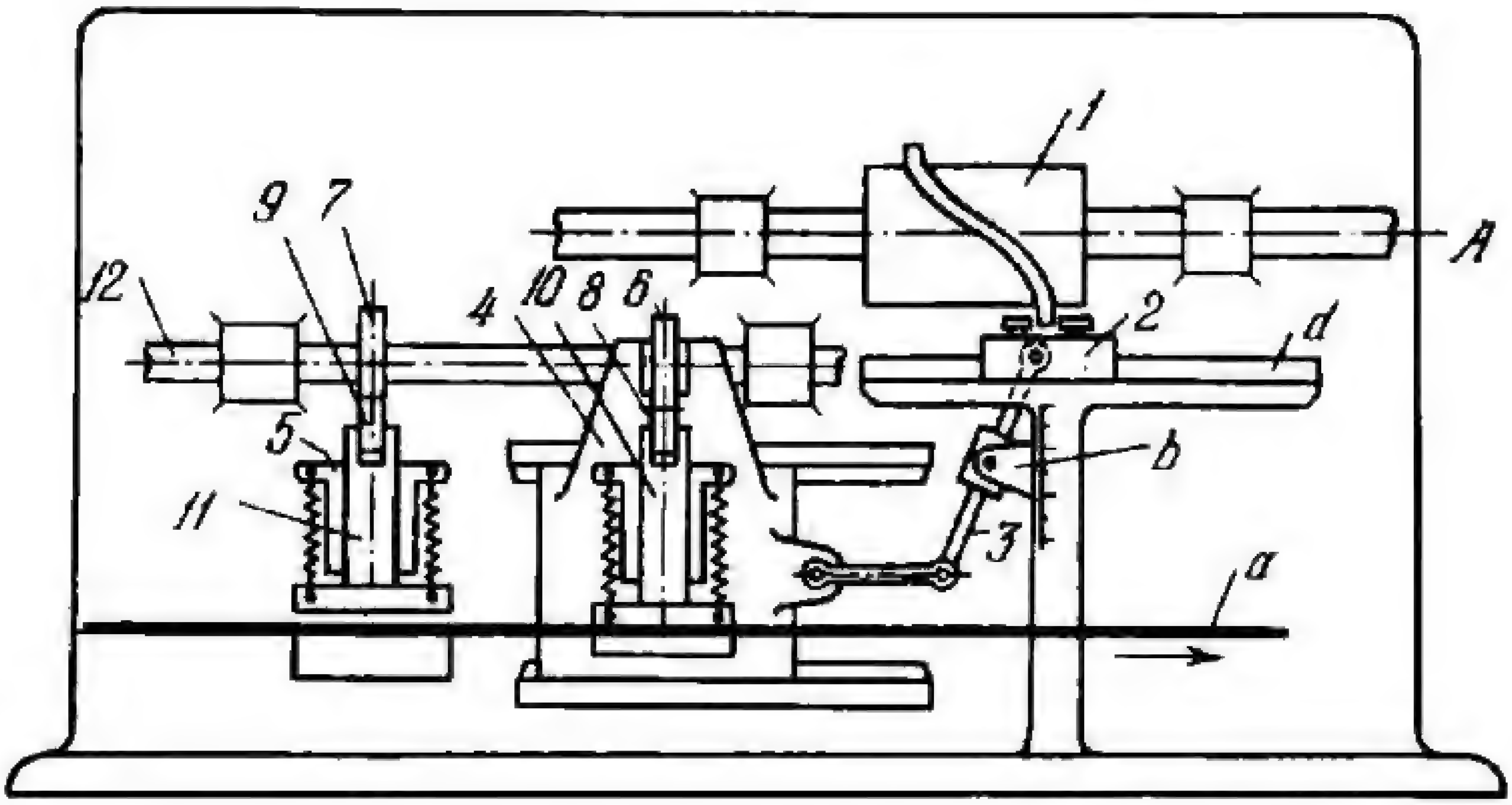


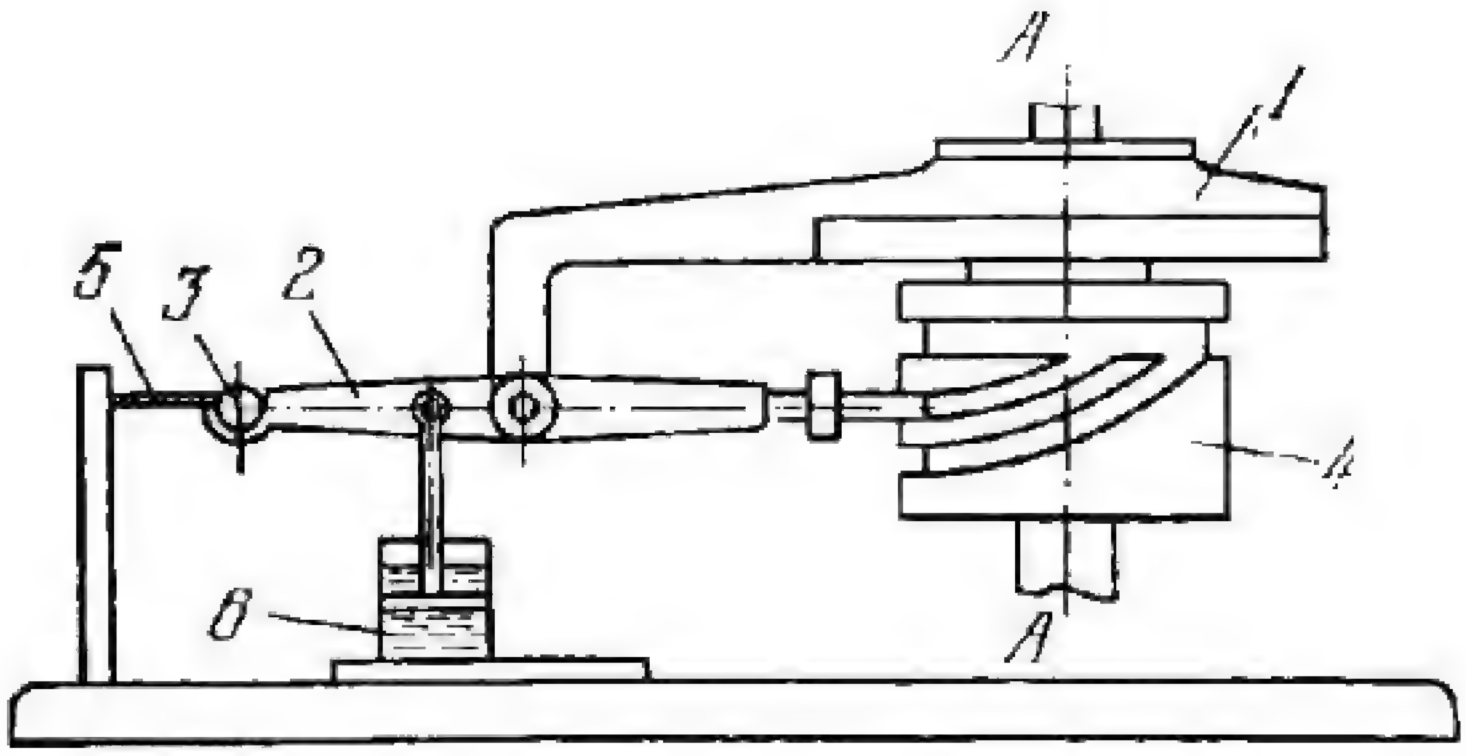
Plate cam 2 rotates about fixed axis A. Swinging carrier 1 oscillates about fixed axis B and has roller 6 which rolls along the working surface of cam 2. Cylindrical blank a is fed by carrier 1 to spindle 3, where it is clamped in a collet chuck. After the blank is clamped, carrier 1 is returned to its initial position by spring 4. Member 5 turns about axis C of carrier 1 and supports the blank. Member 5 is held in contact with the blank by spring 7.

3248	CAM-LEVER SPATIAL STRIP FEED MECHANISM	CmL SF



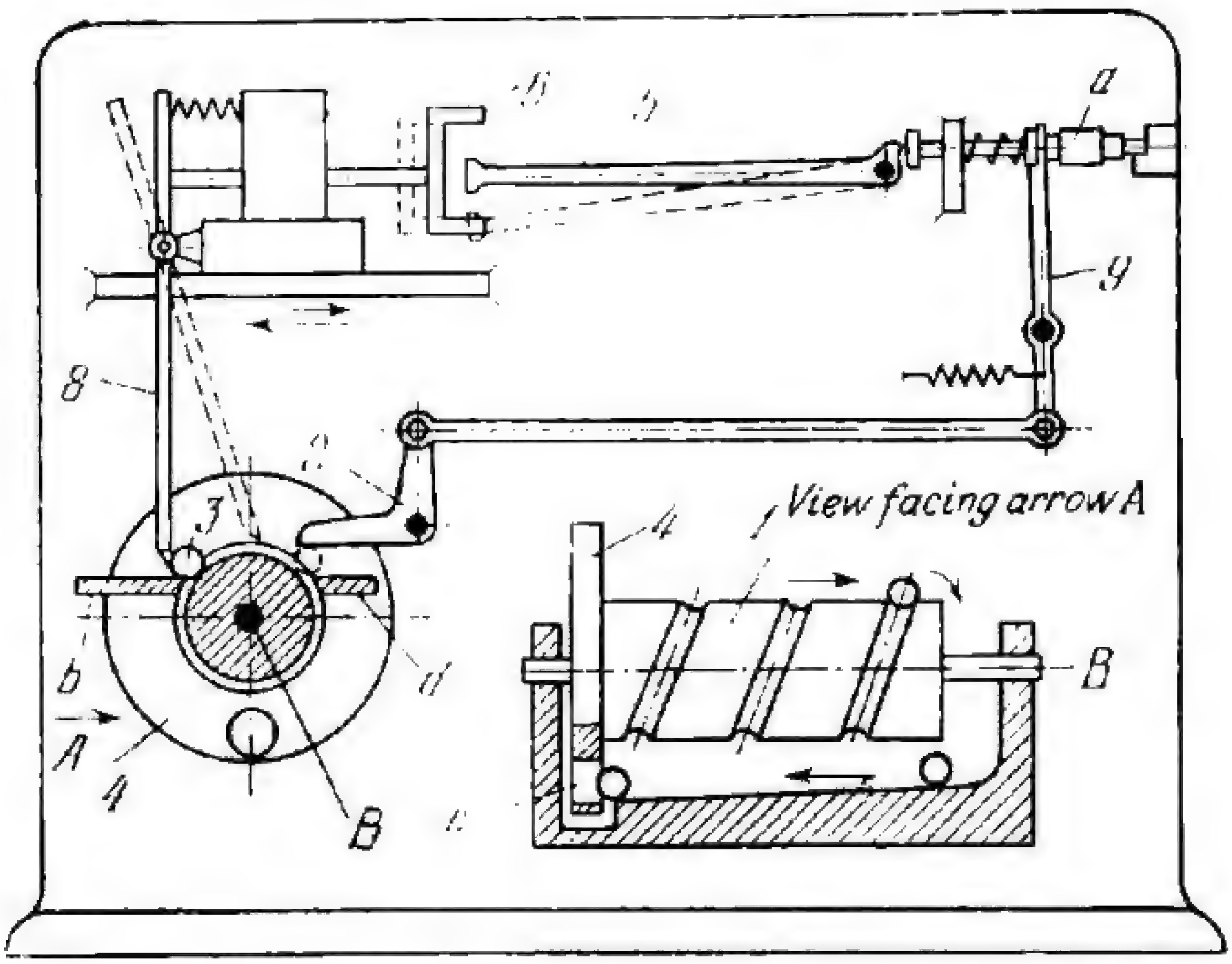
When cylindrical ridge cam *1* rotates about fixed axis *A*, slide *2* reciprocates along fixed guide *d* with dwells at each end of its stroke. The motion of slide *2* is transmitted by lever *3* to travelling clamp *4*. By means of plate cams *6* and *7*, keyed to and rotating with shaft *12*, and follower rollers *8* and *9*, mounted on plungers *10* and *11* and rolling along cams *6* and *7*, travelling clamp *4* and stationary clamp *5* alternately clamp and unclamp strip *a*. Stationary clamp *5* prevents strip motion to the left. Travelling clamp *4* grips strip *a* and feeds it to the right. The amount of feed per revolution of cam *1* can be varied by adjusting bearing *b* of lever *3* vertically and clamping it in the required position.

3249	CAM-LEVER SPATIAL SORTING MECHANISM WITH A FIXED CAM	CmL SF



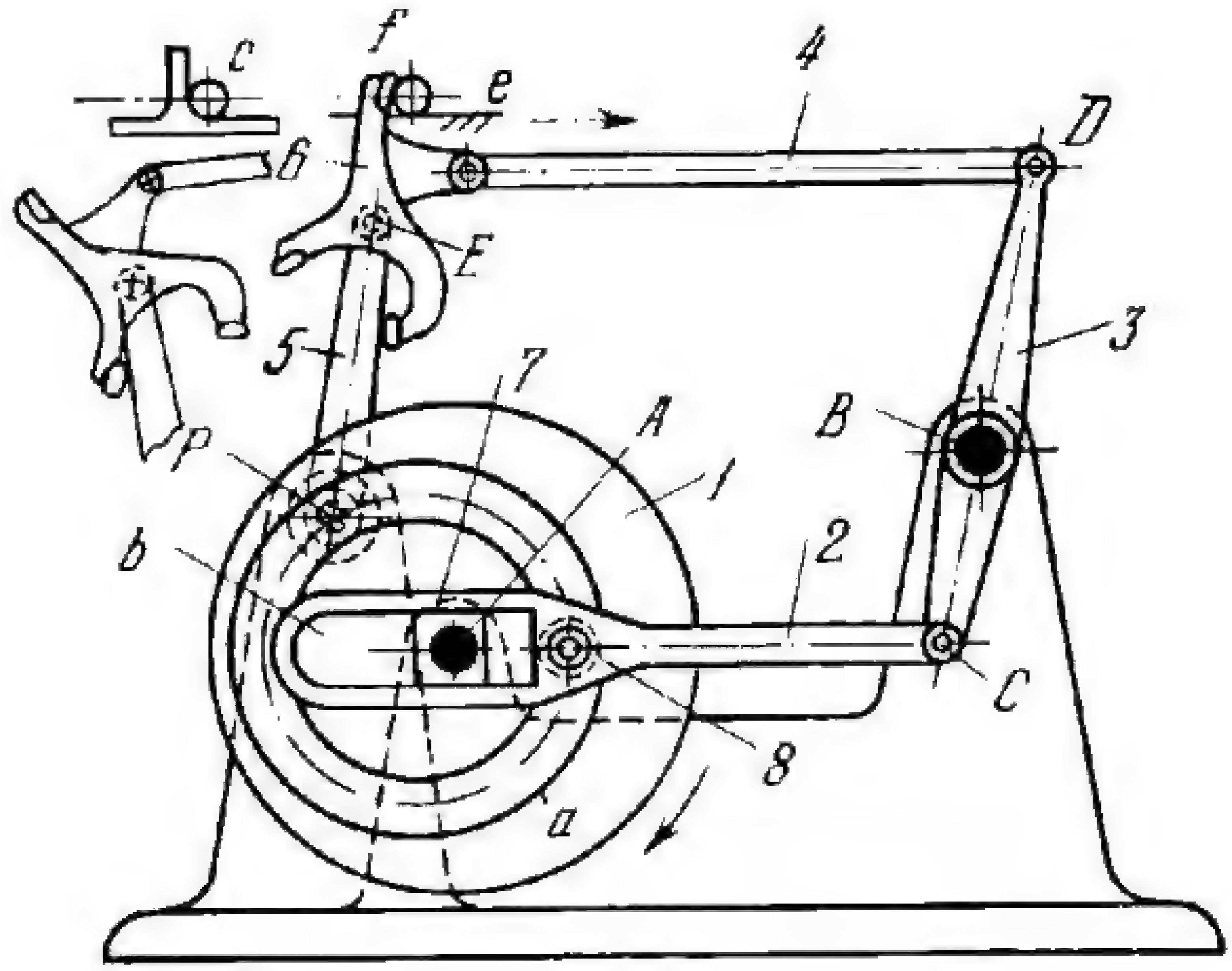
Revolving member *1* rotates continuously about fixed axis *A-A* and carries beam members *2* into whose cups workpieces *3* are fed by an automatic loading device. In a definite sector of its rotation, each member *2* is disengaged from fixed cylinder cam *4* and has a swinging motion. Depending on the weight of workpiece *3* it carries, the right-hand end of beam member *2* enters one of the three grooves of cam *4* which are located one above another. In the position indexed in this manner, member *2* carries its workpiece *3* to one of three ejectors *5*, positioned at different heights and located one after the other. Each beam member has its oil-type shock absorber (buffer) *6*.

3250 | **CAM-LEVER SPATIAL SORTING MECHANISM** | CmL SF



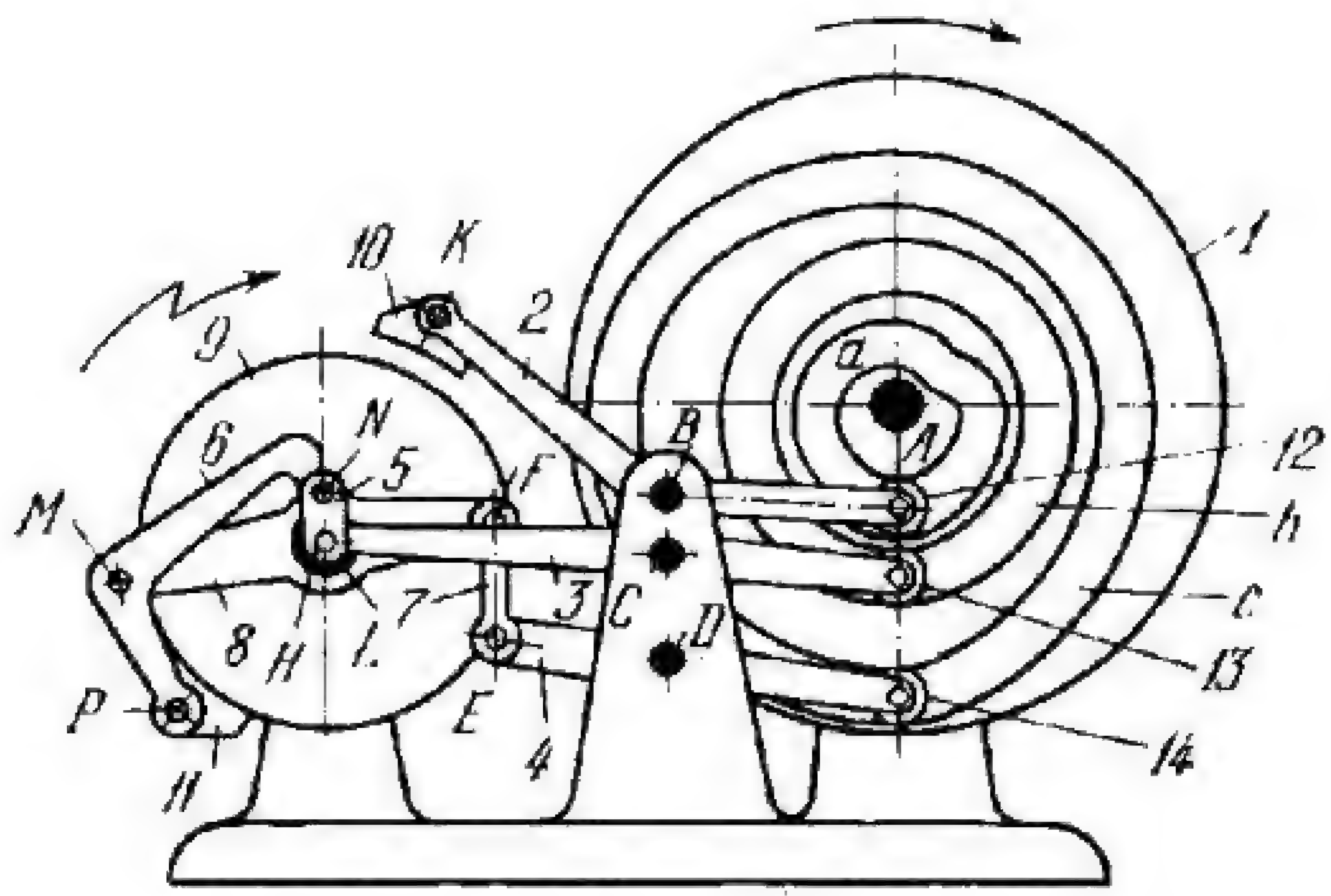
Cylinder cam *1* with a helical groove rotates about fixed axis *B* in synchrony with the conveyer system that transfers the workpieces from one inspection station to the next. Rolling along shelf *b*, in engagement with each turn of the helical groove, are balls *3*, each ball accompanying its workpiece *a* which is being transferred by the conveyer system from station to station. If the workpiece is within size, it is carried to the end by the conveyer system and drops into the within-size box. At the same time, its ball *3* rolls along all the turns of the helical groove on cam *1*, drops down, rolls back into hole *c* in disk *4* which lifts it again to shelf *b*, and begins to roll in engagement with the helical groove again. If the workpiece is rejected at any inspection station, lever *5* is deflected from its central position, and stop *6*, reciprocating with slide *7*, runs up against lever *5*. This turns lever *8* so that it throws ball *3* to the other side of cam *1* where it rolls along shelf *d* in engagement with the helical groove (shown by the dotted line). Now it accompanies rejected workpiece *a* and when ball *3* reaches the end of the helical groove, it lifts lever *2*. Through a system of intermediate links, this deflects lever *9*, releasing workpiece *a* which drops into the reject box.

3251	CAM-LEVER FEEDING MECHANISM	CmL SF



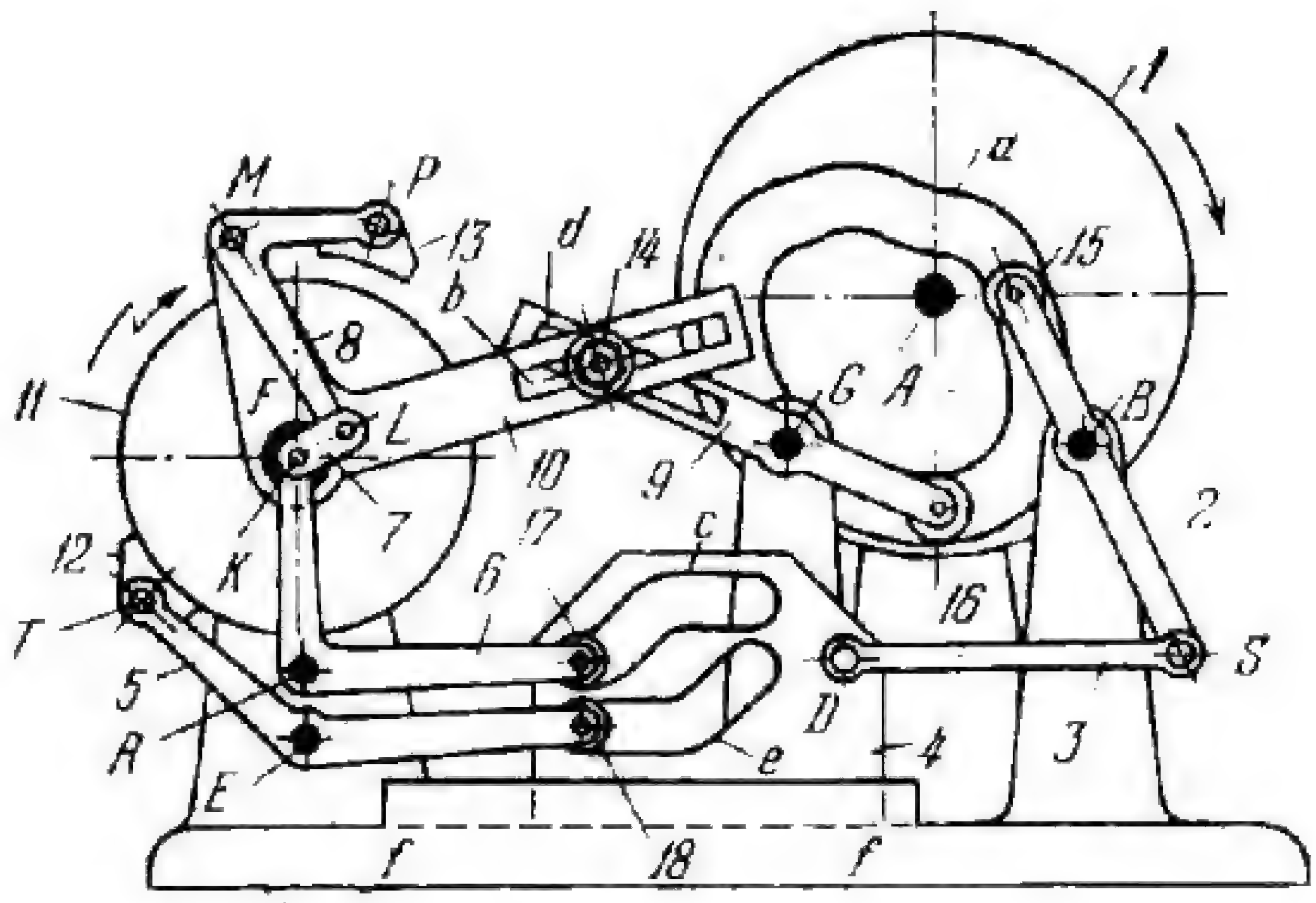
Face cam *1* rotates about fixed axis *A* and has profiled groove *a* along which roller *8* of follower *2* rolls and slides. Follower *2* has straight slot *b* which reciprocates along slider *7*. Slider *7* turns about axis *A*. Rocker arm *3* oscillates about fixed axis *B* and is connected by turning pairs *C* and *D* to follower *2* and to link *4*. Lever *5* turns about fixed axis *P* and is connected by turning pair *E* to shaped member *6* which, in turn, is connected by a turning member to link *4*. Member *6* has arm *f* which engages the workpiece and transfers it from station *c* to station *e* when link *4* travels to the right. When link *4* travels to the left, it first turns member *6* counterclockwise about axis *E* so that arm *f* passes under the next workpiece at station *c*. To ensure that link *4* first turns member *6* in its motion in both directions, lever *5* is retarded by a friction drag (not shown).

3252	CAM-LEVER FEEDING MECHANISM WITH DWELLS OF THE DRIVEN DRUM	CmL SF



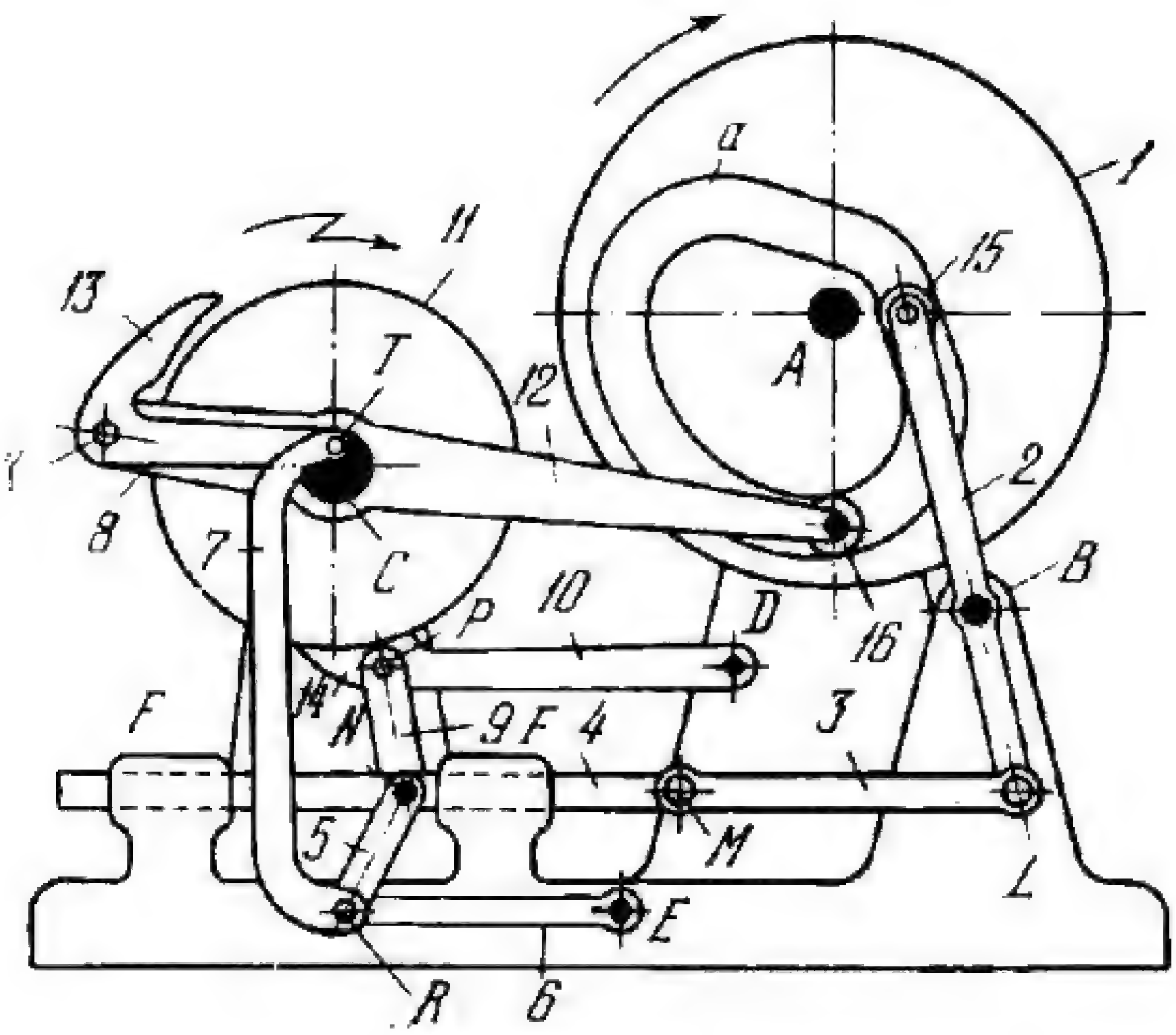
Face cam *1* rotates about fixed axis *A* and has three profiled grooves, *a*, *b* and *c*. Followers *2*, *3* and *4* oscillate about fixed axes *B*, *C* and *D* and carry rollers *12*, *13* and *14* which roll and slide along grooves *a*, *b* and *c*. Shoe *10* turns freely about axis *K* of follower *2*. Link *7* is connected by turning pairs *E* and *F* to follower *4* and to link *8*. Link *5* is connected by turning pairs *N* and *H* to links *6* and *3*. Link *8* oscillates about fixed axis *L* and is connected by turning pairs *F* and *M* to links *7* and *6*. Shoe *11* turns freely about axis *P* of link *6*. Driven drum *9* rotates freely about axis *L*. When cam *1* rotates continuously, drum *9* rotates intermittently with dwells. Rotation of the drum, corresponding to the feeding process of the material, is accomplished by shoe *11* during the periods when it is pressed against the surface of the drum and shoe *10* is withdrawn from the surface. Dwells of the drum occur when shoe *10* is pressed against its surface and shoe *11* is withdrawn.

3253	CAM-LEVER FEEDING MECHANISM WITH DWELLS OF THE DRIVEN DRUM	CmL SF



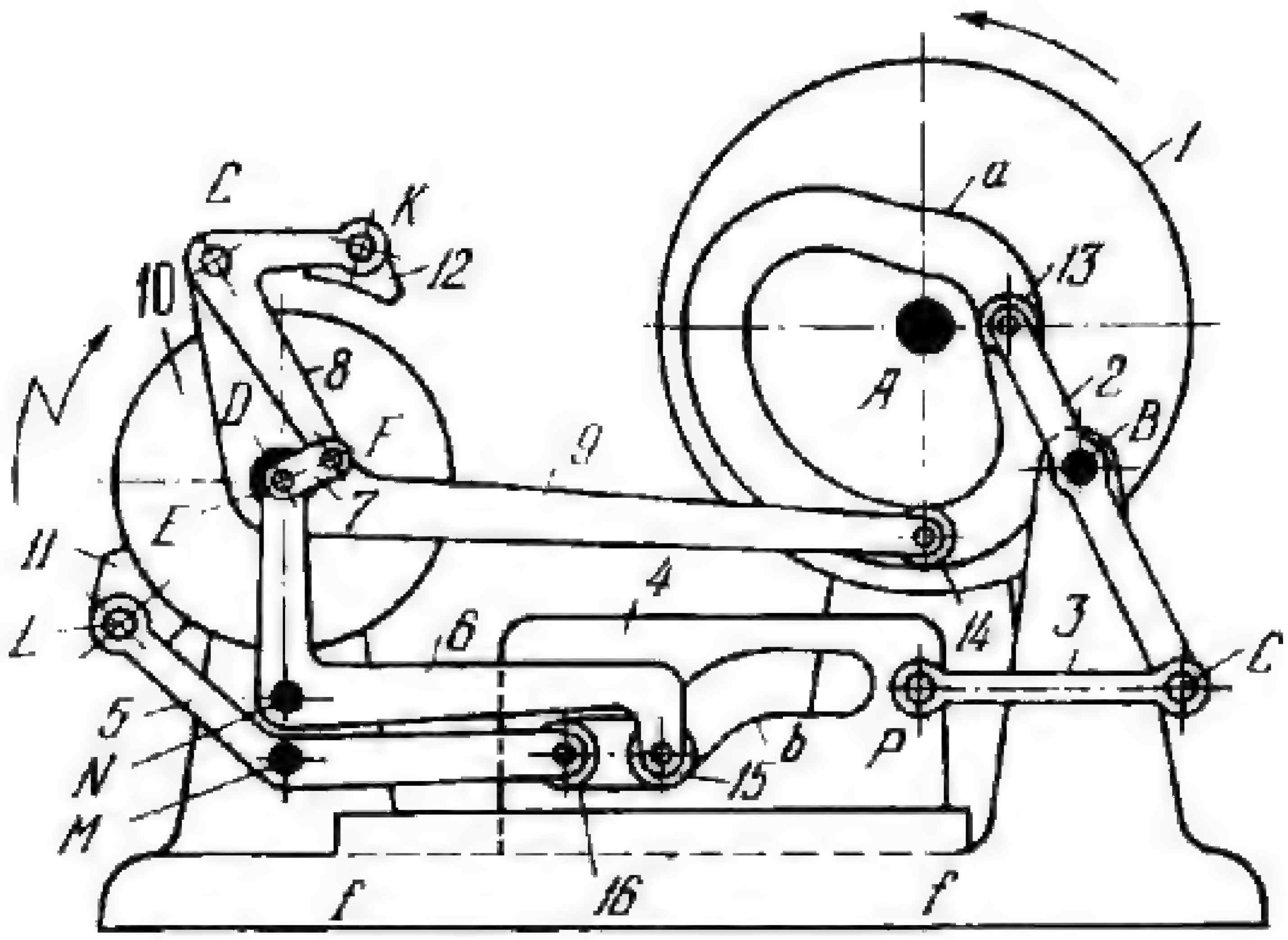
Face cam *1* rotates about fixed axis *A* and has profiled groove *a*. Followers *2* and *9* oscillate about fixed axes *B* and *G*, and carry rollers *15* and *16* which roll and slide along groove *a*. Driven drum *11* rotates freely about fixed axis *F*. Shoe *13* turns freely about axis *P* of link *8* which is connected by turning pairs *M* and *L* to links *10* and *7*. Link *10* oscillates about axis *F* and has straight slot *b*. Follower *9* has straight slot *d*. Bolt *14*, used to adjust the mechanism, can be set in various positions along slots *b* and *d*, and clamped so that it slides along either slot *b* or slot *d*. Link *7* is connected by turning pair *K* to bellcrank lever *6* which oscillates about fixed axis *R*. Shoe *12* turns freely about axis *T* of bellcrank lever *5* which oscillates about fixed axis *E*. Levers *6* and *5* carry rollers *17* and *18* which roll and slide along cam slots *c* and *e* of sliding cam *4*. Cam *4* reciprocates along fixed guides *f-f* and is driven by connecting rod *3* which is connected by turning pairs *D* and *S* to cam *4* and to follower *2*. When cam *1* rotates continuously, drum *11* rotates intermittently with dwells. Rotation of the drum, corresponding to the feeding process of the material, is accomplished by shoe *13* during the periods when it is pressed against the surface of the drum and shoe *12* is withdrawn from the surface. Dwells of the drum occur when shoe *12* is pressed against its surface and shoe *13* is withdrawn.

3254	CAM-LEVER FEEDING MECHANISM WITH DWELLS OF THE DRIVEN DRUM	CmL SF



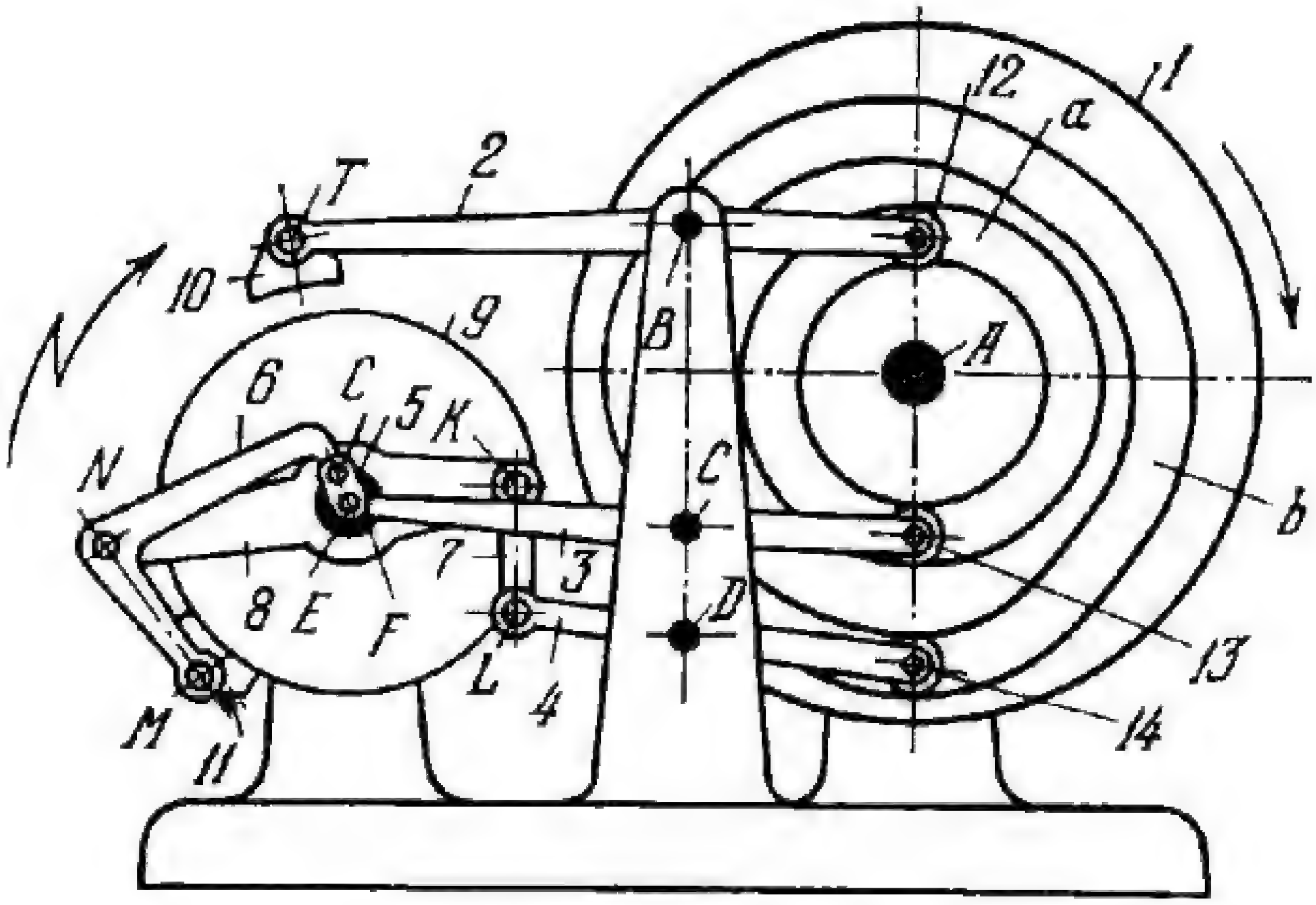
Face cam *1* rotates about fixed axis *A* and has profiled groove *a*. Followers *2* and *12* oscillate about fixed axes *B* and *C*, and carry rollers *15* and *16* which roll and slide along groove *a*. Driven drum *11* rotates freely about axis *C*. Link *8* has rigidly attached shoe *13* and is connected by turning pairs *K* and *T* to follower *12* and to link *7*. Link *10* turns about fixed axis *D* and has rigidly attached shoe *14*. Connecting rod *3* is connected by turning pairs *L* and *M* to follower *2* and to slide *4* which reciprocates in fixed guides *F-F*. Link *9* is connected by turning pairs *N* and *P* to slide *4* and to link *10*. Link *5* is connected by turning pairs *N* and *R* to slide *4* and to link *6* which turns about fixed axis *E*. When cam *1* rotates continuously, drum *11* rotates intermittently with dwells. Rotation of the drum, corresponding to the feeding process of the material, is accomplished by shoe *13* during the periods when it is pressed against the surface of the drum and shoe *14* is withdrawn from the surface. Dwells of the drum occur when shoe *14* is pressed against its surface and shoe *13* is withdrawn.

3255	CAM-LEVER FEEDING MECHANISM WITH DWELLS OF THE DRIVEN DRUM	CmL SF



Face cam *1* rotates about fixed axis *A* and has profiled groove *a*. Followers *2* and *9* oscillate about fixed axes *B* and *D*, and carry rollers *13* and *14* which roll and slide along groove *a*. Driven drum *10* rotates freely about axis *D*. Shoe *12* turns freely about axis *K* of link *8* which is connected by turning pairs *C* and *F* to follower *9* and to link *7*. Link *7* is connected by turning pair *E* to bellcrank lever *6* which oscillates about fixed axis *N*. Shoe *11* turns freely about axis *L* of bellcrank lever *5* which oscillates about fixed axis *M*. Levers *6* and *5* carry rollers *15* and *16* which roll and slide along cam slot *b* of sliding cam *4*. Cam *4* reciprocates along fixed guides *f-f* and is driven by connecting rod *3* which is connected by turning pairs *P* and *C* to cam *4* and to follower *2*. When cam *1* rotates continuously, drum *10* rotates intermittently with dwells. Rotation of the drum, corresponding to the feeding process of the material, is accomplished by shoe *12* during the periods when it is pressed against the surface of the drum and shoe *11* is withdrawn from the surface. Dwells of the drum occur when shoe *11* is pressed against its surface and shoe *12* is withdrawn.

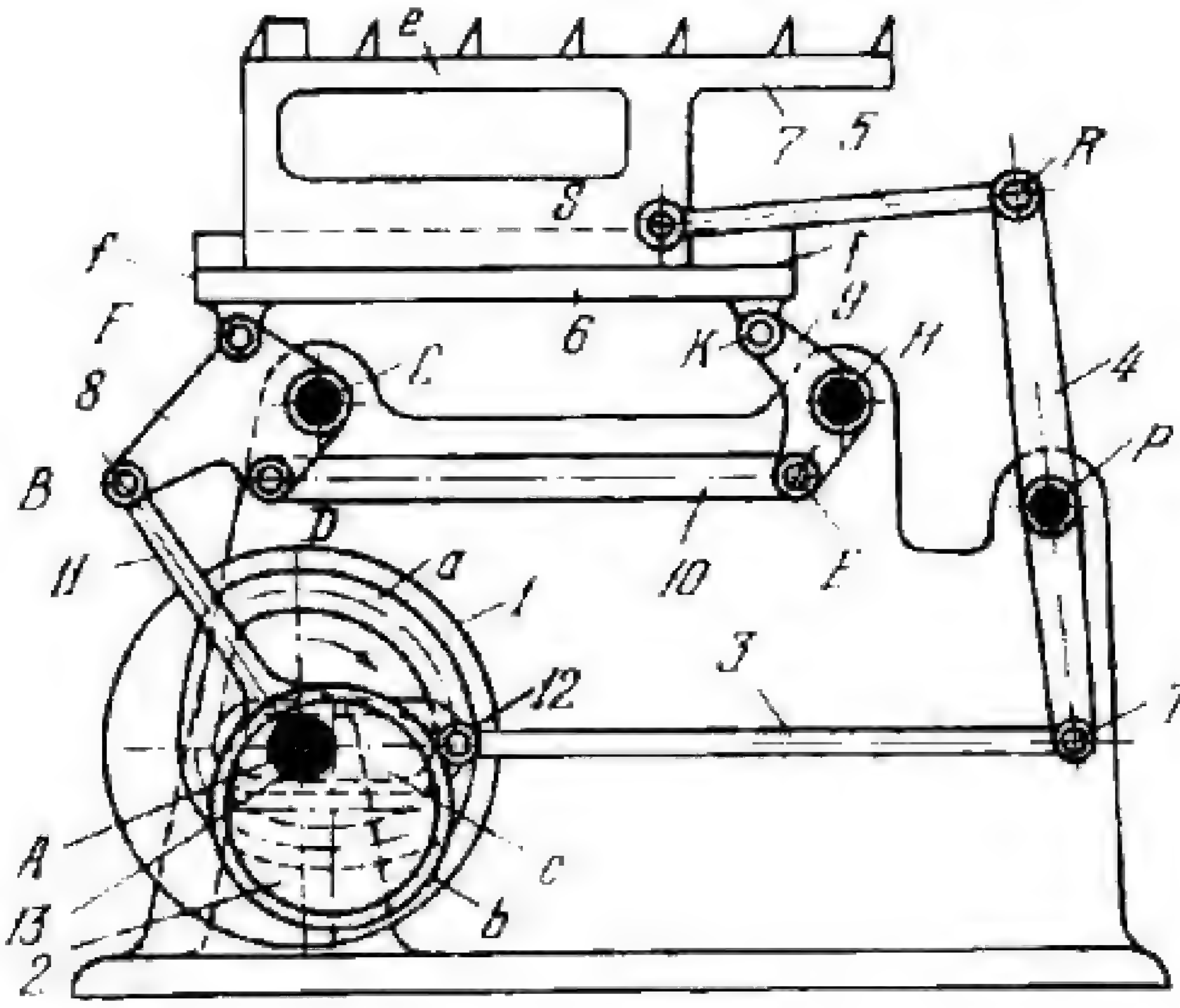
3256	CAM-LEVER FEEDING MECHANISM WITH DWELLS OF THE DRIVEN DRUM	CmL SF



Face cam *1* rotates about fixed axis *A* and has two profiled grooves *a* and *b*. Followers *2*, *3* and *4* oscillate about fixed axes *B*, *C* and *D*, and carry rollers *12*, *13* and *14* which roll and slide along grooves *a* (rollers *12* and *13*) and *b* (roller *14*). Shoe *10* turns freely about axis *T* of follower 2. Link *7* is connected by turning pairs *L* and *K* to follower *4* and to link *8*. Link *8* oscillates about fixed axis *E* and is connected by turning pair *N* to link *6*. Shoe *11* turns freely about axis *M* of link *6*. Link *5* is connected by turning pairs *C* and *F* to link *6* and to follower *3*. Driven drum *9* rotates freely about axis *E*. When cam *1* rotates continuously, drum *9* rotates intermittently with dwells. Rotation of the drum, corresponding to the feeding process of the material, is accomplished by shoe *11* during the periods when it is pressed against the surface of the drum and shoe *10* is withdrawn from the surface. Dwells of the drum occur when shoe *10* is pressed against its surface and shoe *11* is withdrawn.

10. MECHANISMS OF MATERIALS HANDLING EQUIPMENT (3257)

3257	CAM-LEVER LOAD TRANSFER MECHANISM	CmL MH



Face cam *1* rotates about fixed axis *A* and has profiled groove *a*. Cam *1* and round eccentric *2* are keyed to drive shaft *13*. Connecting rod *11* has collar *b* encircling eccentric *2* and is connected by turning pair *B* to lever *8* which oscillates about fixed axis *C*. Connecting link *10* is connected by turning pairs *D* and *E* to lever *8* and to lever *9* which oscillates about fixed axis *H*. Bracket *6* is connected by turning pairs *F* and *K* to levers *8* and *9*, and has guides *f-f* along which slide *7* reciprocates. Slide *7* has two carriers *e* which support and transfer the load. Yoke *3* has slot *c* which slides along shaft *13*, and carries roller *12* which rolls and slides along groove *a* of cam *1*. Yoke *3* is connected by turning pair *T* to lever *4* which oscillates about fixed axis *P* and is connected by turning pair *R* to connecting rod *5*. Connecting rod *5* is connected by turning pair *S* to slide *7*. The lengths of the links comply with the conditions: $\overline{FK} = \overline{CH} = \overline{DE}$, $\overline{CF} = \overline{HK}$ and $\overline{CD} = \overline{HE}$. Thus links *6*, *8*, *10* and *9* form a double parallel-crank linkage and, consequently, slide *7* and carriers *e* have a circular translational motion. When cam *1* and eccentric *2* rotate, carriers *e* are first raised with the load while a dwell (concentric portion) of cam *1* keeps slide *7* from moving along bracket *6*. When carriers *e* reach their upper position, cam *1* operates lever *4*, moving slide *7* and carriers *e* with the load to the right. Then eccentric *2* lowers bracket *6* so that the load is deposited at the next station and carriers *e* clear the bottom of the load. The cycle ends when cam *1* returns slide *7* to its initial position and is under the next load.

3258	CAM-LEVER FEEDING MECHANISM OF AN AUTOMATIC WRIST PIN GAUGING MACHINE	CmL M

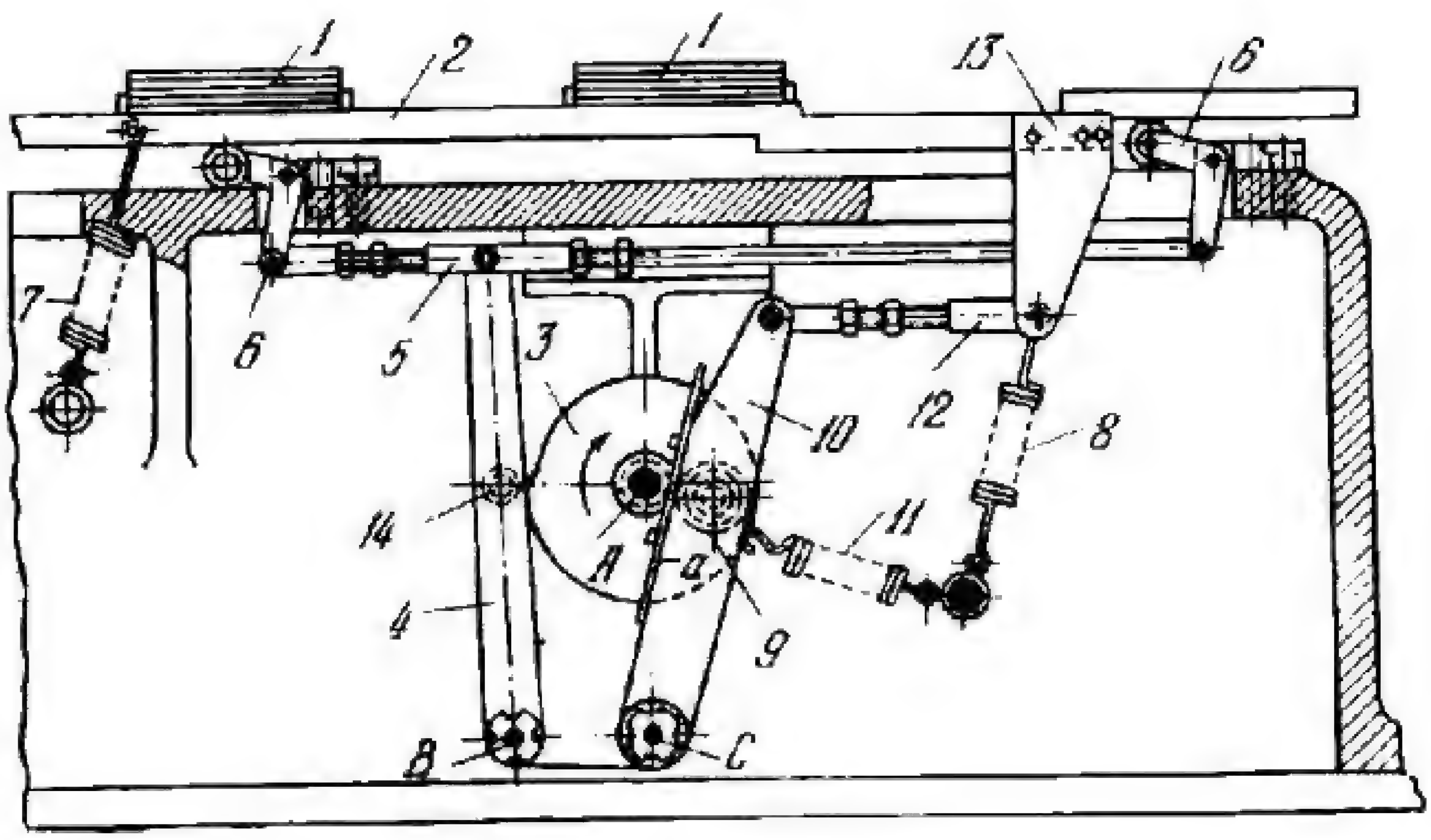
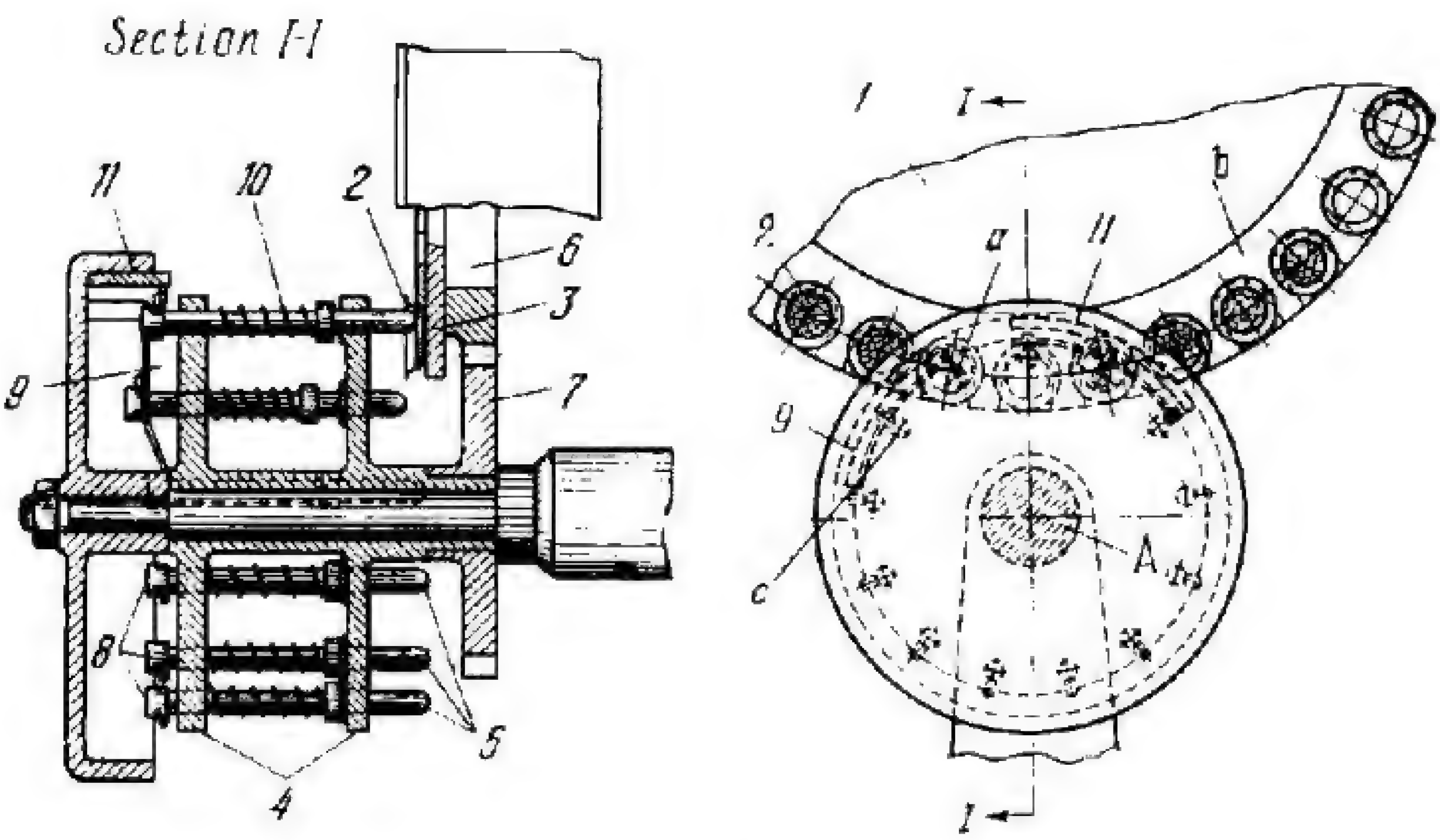


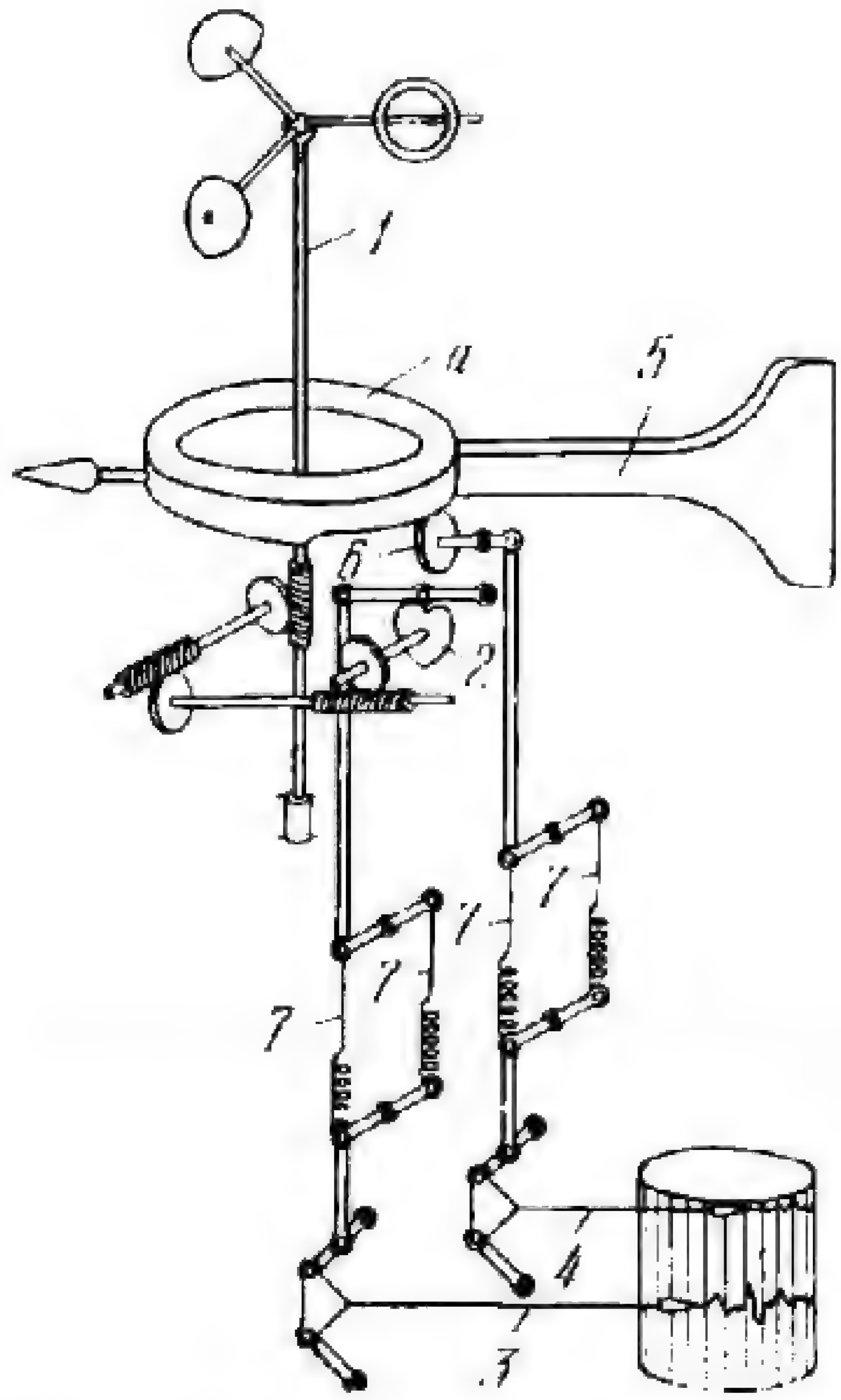
Plate cam *3* rotates about fixed axis *A*. Follower *4* oscillates about fixed axis *B* and carries roller *14* which rolls along the working surface of cam *3*. Roller *9* of cam *3* rolls along strip *a* which is rigidly attached to follower *10* and is held against roller *9* by spring *11*. Workpiece *1* to be inspected is delivered by the feeding facilities onto bar *2*. When cam *3* rotates, bar *2* travels along a path having the form of a closed rectangle: upward, to the left, downward and to the right. The up and down motions are provided by bellcrank levers *6*, on which bar *2* lies, and springs *7* and *8*. Levers *6* are oscillated by cam *3* through follower *4* and tie-rod *5*. Motions to the right and left are provided by roller *9* of cam *1* through follower *10*, tie-rod *12* and bracket *13*, which is rigidly attached to bar *2*.

3259	CAM-LEVER INSPECTION MECHANISM	CmL M



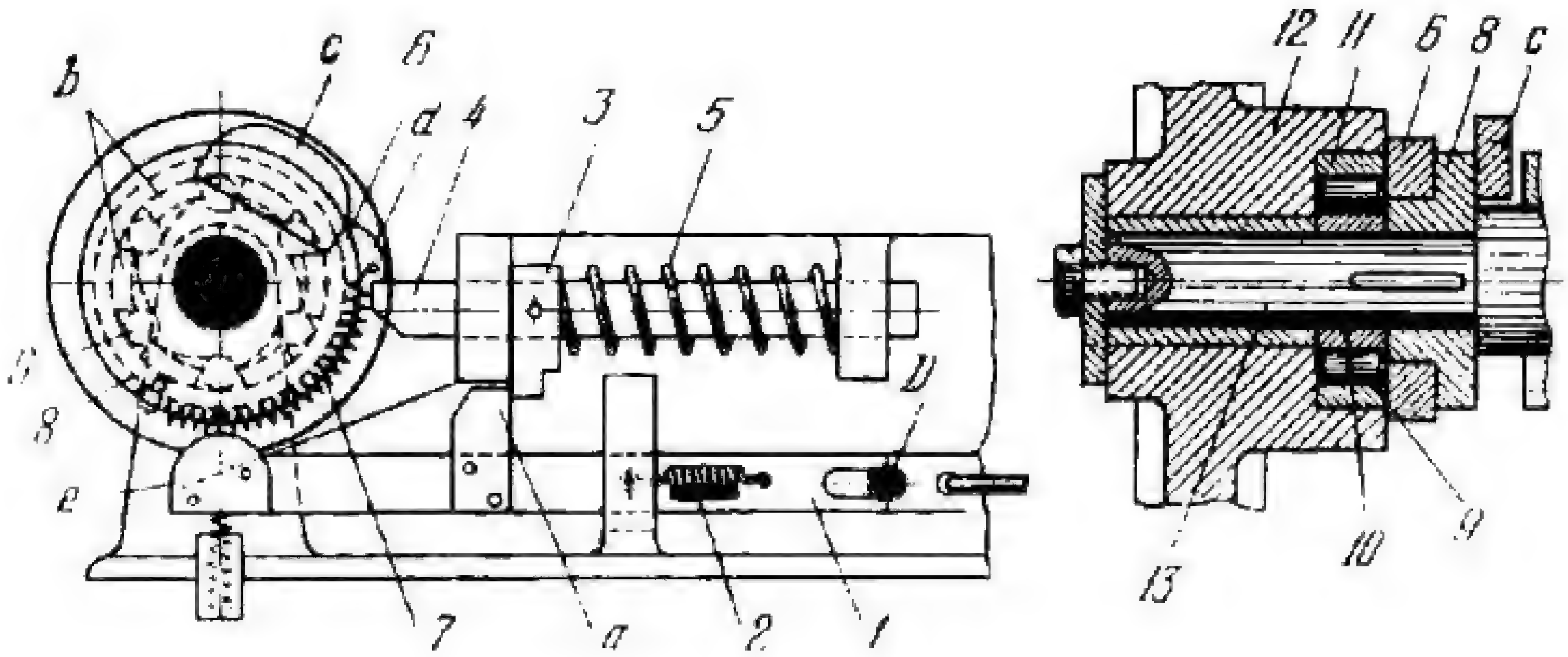
Conveyer wheel *1* carries caps *2* into which cork disks *3* have been assembled automatically in a previous operation. The purpose of the inspection mechanism is to check whether all the caps contain cork disks and to remove caps which do not. Caps *2* are carried in recesses of ring *b* which is rigidly attached to wheel *1*. Flanges *4* are rigidly attached together and to gear *7*, and rotate about fixed axis *A*. Gear *7* meshes with ring gear *6* which is rigidly attached to wheel *1*. Flanges *4* carry sliding plungers *5* and are rotated through gears *6* and *7* so that each plunger engages a cap. The plungers are held down by light springs *10*. Lifters *8* at the top end of plungers *5* contact the working surfaces of fixed cams *9* and *11*. Cam *9* pulls the plungers upward at position *c*, compressing springs *10*, and releases them at position *a* so that each plunger drops into a cap. If the given cap *2* has a cork disk *3*, the corresponding plunger *5* rests on the disk and its lifter *8* is high enough to engage cam *11* which lifts the plunger out of the cap. If the cap has no cork disk, plunger *5* rests on the bottom of the cap and its lifter *8* is too low to engage cam *11* under which it passes. Since, in this case, the plunger is not lifted by cam *11* out of the cap, the latter is pushed by the plunger off conveyer wheel *1*. The distance between the centres of the plungers equals the distance between the centres of the caps in their recesses on wheel *1*.

3260	CAM-LEVER MECHANISM OF THE TRETYAKOV ANEMOGRAPH	CmL M



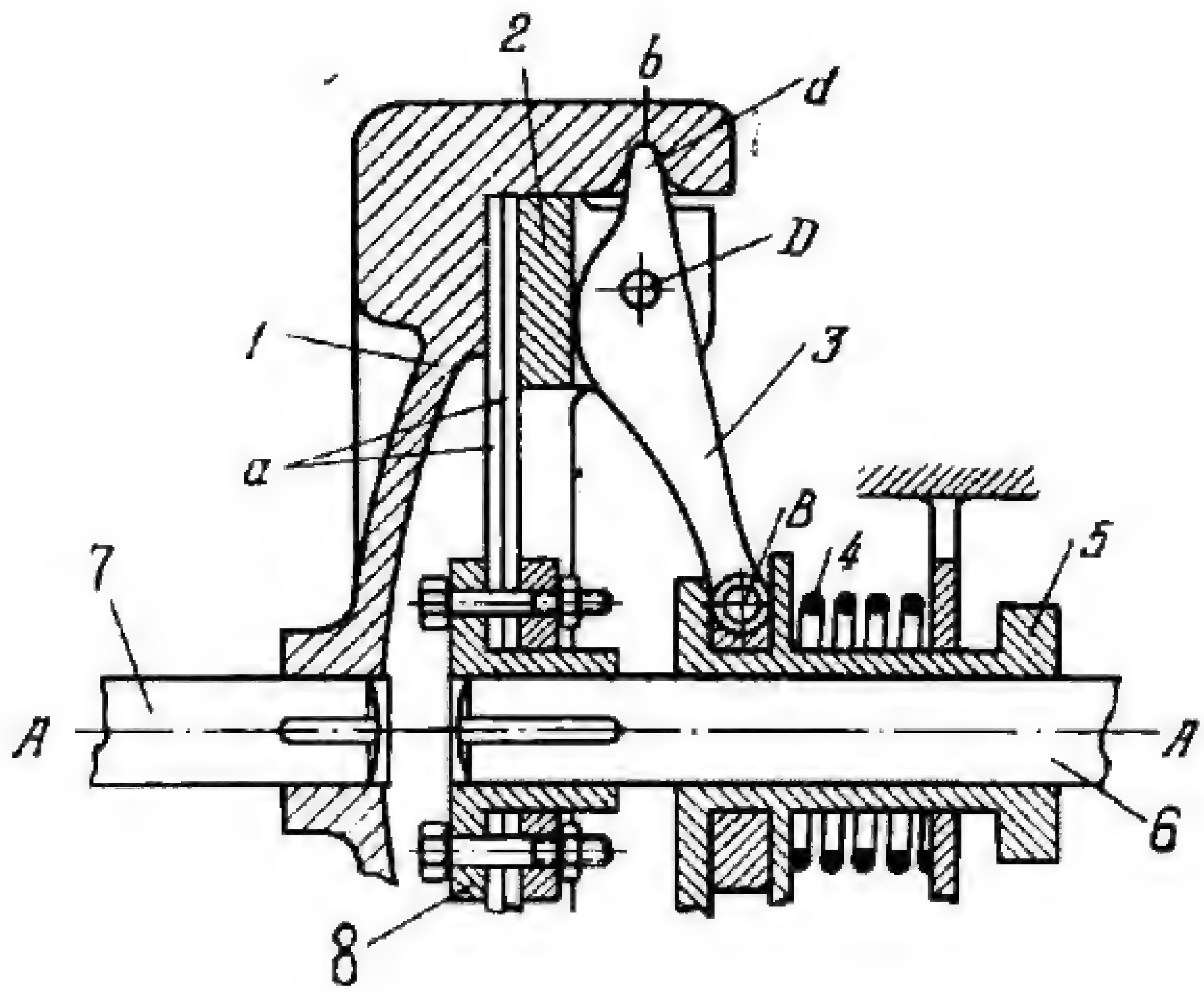
Shaft *1* of the anemograph cup wheel rotates cam *2* through three worm gearing units, converting the rotation of the shaft into vertical displacement of pen *3* of the registering mechanism. The angular displacement of weathervane *5* is transmitted in a similar manner to pen *4*. Ring *a*, rigidly attached to weathervane *5*, is an end cam along whose lower working surface roller *6* rolls. When weathervane *5* turns, the vertical displacement of roller *6* is transmitted by a lever system to registering pen *4*. Elongation or contraction of one of the wires *7* due to changes in ambient temperature is compensated for by the change in length of the other wire. Thus, variations in temperature do not affect the readings of the instrument.

3261	CAM-LEVER MECHANISM OF A SINGLE-REVOLUTION TRIPPING ROLLER CLUTCH	CmL C



When a starting treadle (not shown) is depressed, plate *1* is pulled to the right against the tension of spring *2*. Latch *a*, in this motion, engages collar *3* and moves it together with latch *4* to the right against the tension of spring *5*. As soon as latch *4* is disengaged from nose *d* of friction roller cage *6*, the latter is turned clockwise by spring *7* which is secured with one end to roller cage *6* and the other to collar *8*, keyed to shaft *13*. As roller cage *6* revolves, its lugs *b* push rollers *9* of the clutch so that they climb up the cam surfaces of cam member *10* and become wedged between the cam member and hardened steel ring *11* press-fitted into revolving flywheel *12*. Since cam member *10* is keyed to shaft *13*, the latter begins to revolve clockwise, together with collar *8*. At this, cam *c* of collar *8* comes into contact with cam *e* at the end of plate *1*, turning the plate downward about fixed axis *D*. This disengages collar *3* from latch *a*, allowing spring *5* to shift latch *4* back to its initial position, ready to engage nose *d* of roller cage *6* when the cage and shaft *13* have made one complete revolution. When nose *d* and cage *6* are stopped by latch *4*, rolls *9* roll along cam member *10* releasing the clutch so that shaft *13* stops. Before the clutch disengages, spring *7* is tensioned again. Thus, shaft *13* makes a single revolution when the starting treadle is depressed and does not repeat even if the treadle remains depressed. For the clutch to be engaged for the next single revolution, the treadle must be released and depressed again.

3262	CAM-LEVER MECHANISM OF A FRICTION CLUTCH	CmL C



Sleeve *5* slides along axis *A-A* on shaft *6* and is connected by turning pair *B* to cam-levers *3* which have lugs *d* engaging annular recess *b* of clutch body *1*. Cam-levers *3* are connected by turning pairs *D* to pressure plate *2*. Owing to the action of spring *4*, the working surface of cam-levers *3* tends to clamp friction disk *a* between the clutch body and pressure plate *2*. Body *1* is keyed to shaft *7*, and sleeve *8* of friction disk *a* can slide along a feather key of shaft *6*. To release the clutch, sleeve *5* is shifted to the right against the tension of spring *4*.

3263	CAM-LEVER VALVE-OPERATING MECHANISM	CmL PM

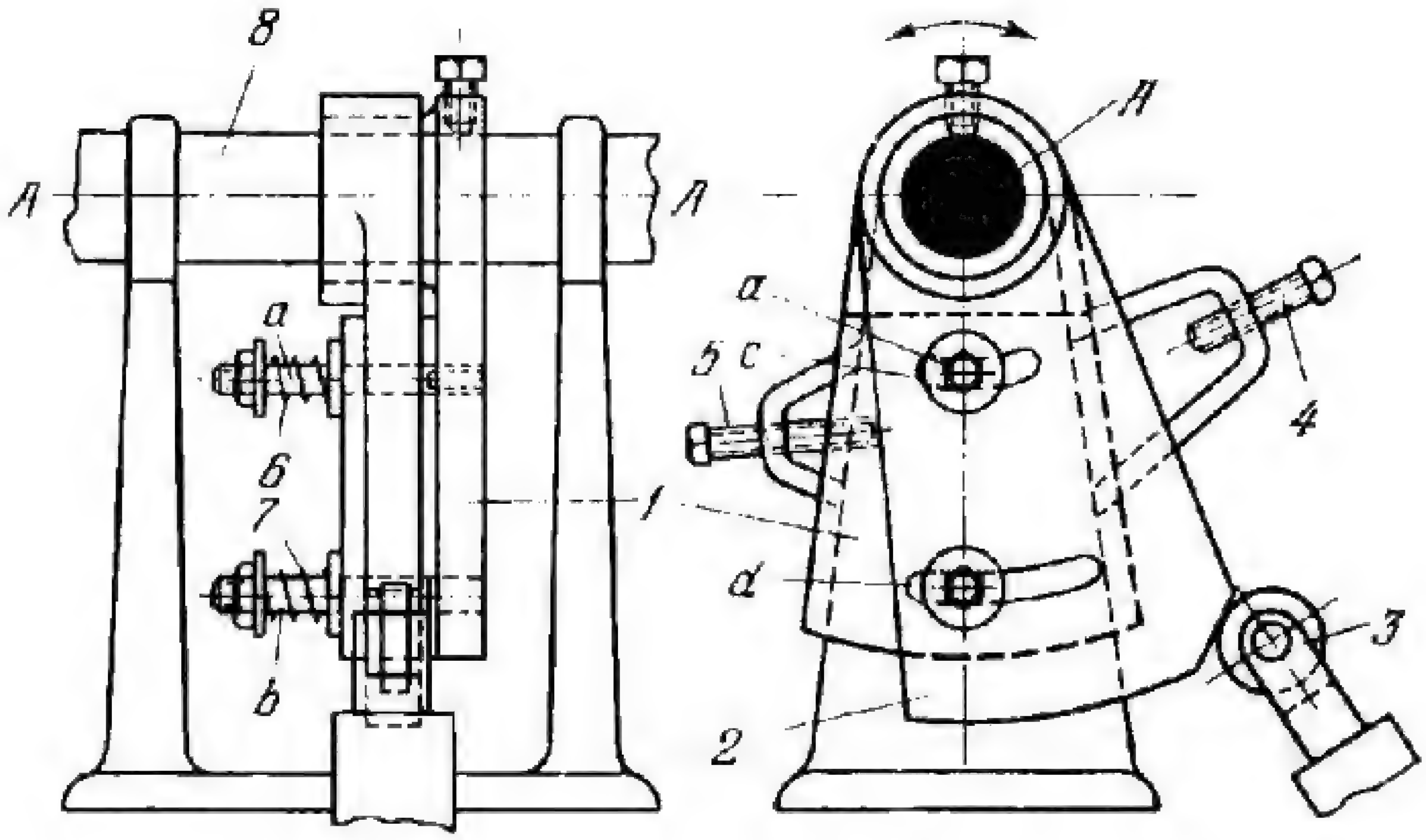
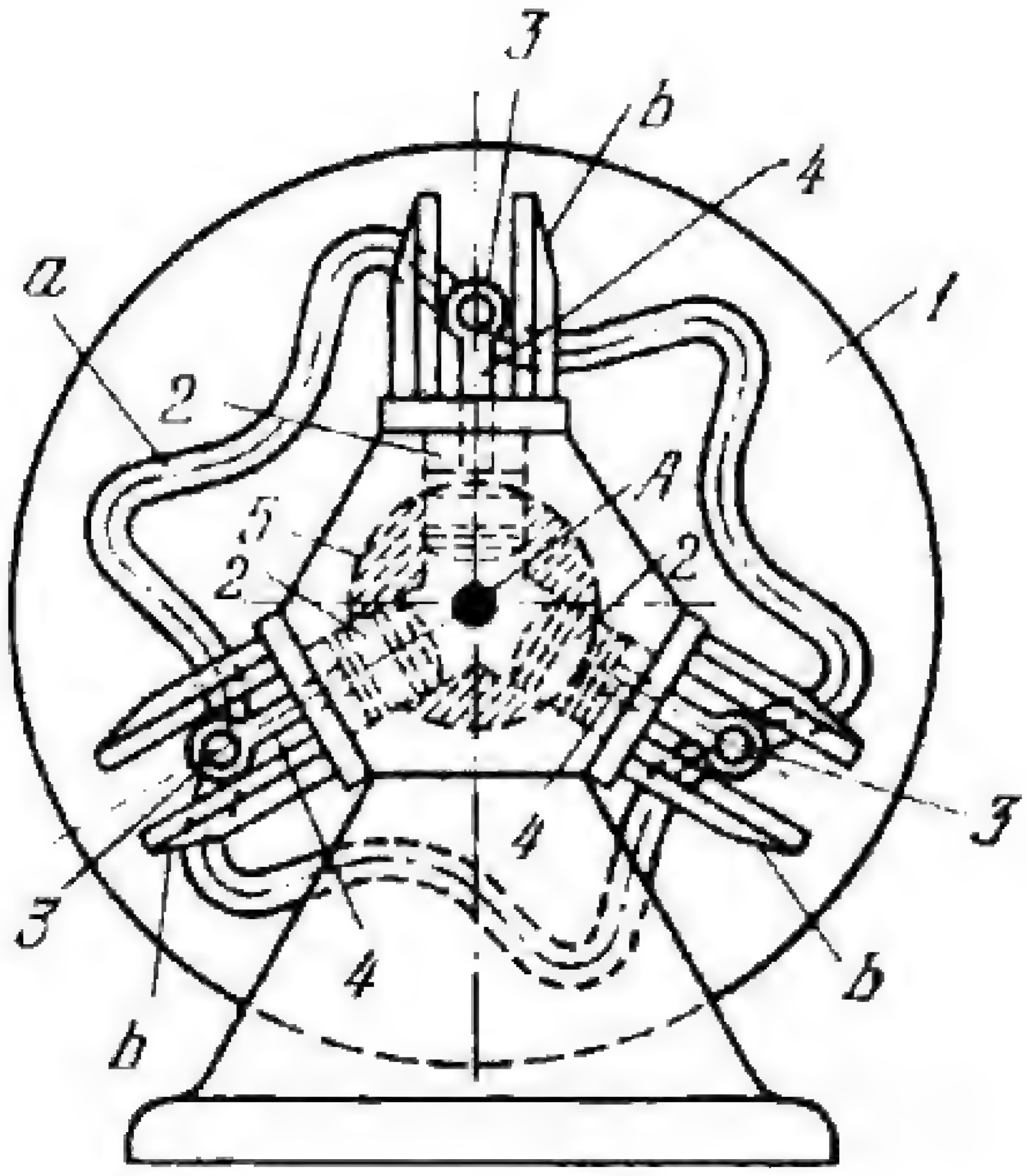


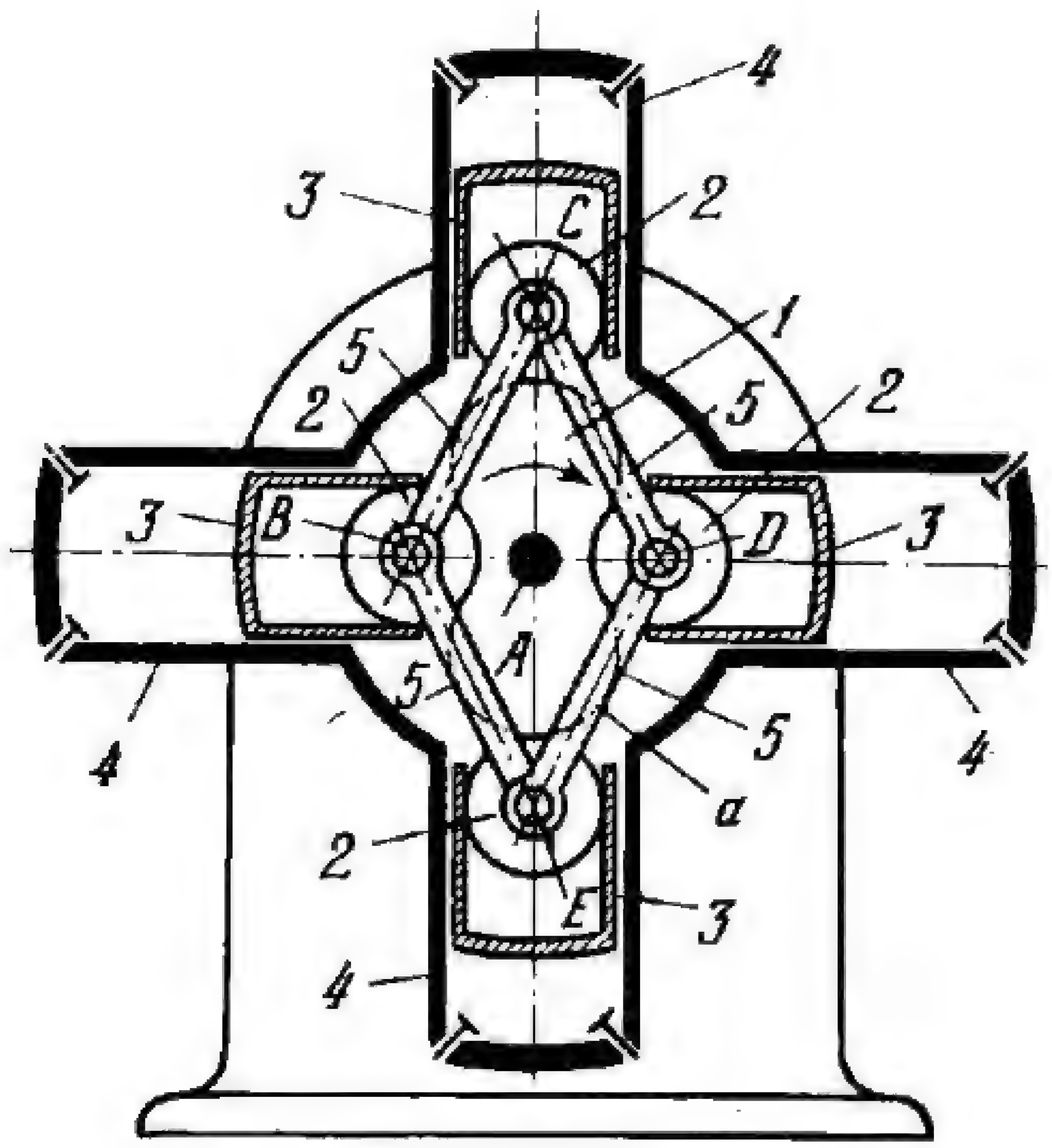
Plate *1* is rigidly clamped to shaft *8* and turns about fixed axis *A-A*. Cam *2* turns freely about axis *A-A* on the sleeve of plate *1* and is attached to the plate by studs *a* and *b* which pass through circular slots *c* and *d* in cam *2*. Springs *6* and *7* produce friction between plate *1* and cam *2* so that they turn together. When shaft *8* turns counterclockwise, plunger *3* is depressed and closes a valve (not shown) as soon as cam *2* reaches screw stop *4*. When shaft *8* turns clockwise, plunger *3* rises, opening the valve at the moment cam *2* reaches screw stop *5*. Screw stops *4* and *5* control the time and amount of plunger motion. If the angle of oscillation of shaft *8* and plate *1* exceeds that set by stops *4* and *5*, then, when cam *2* reaches either of the stops, plate *1* continues to turn, overcoming the friction drag between it and cam *2* due to springs *6* and *7*.

3264	CAM-LEVER THREE-CYLINDER PISTON MACHINE MECHANISM	CmL PM

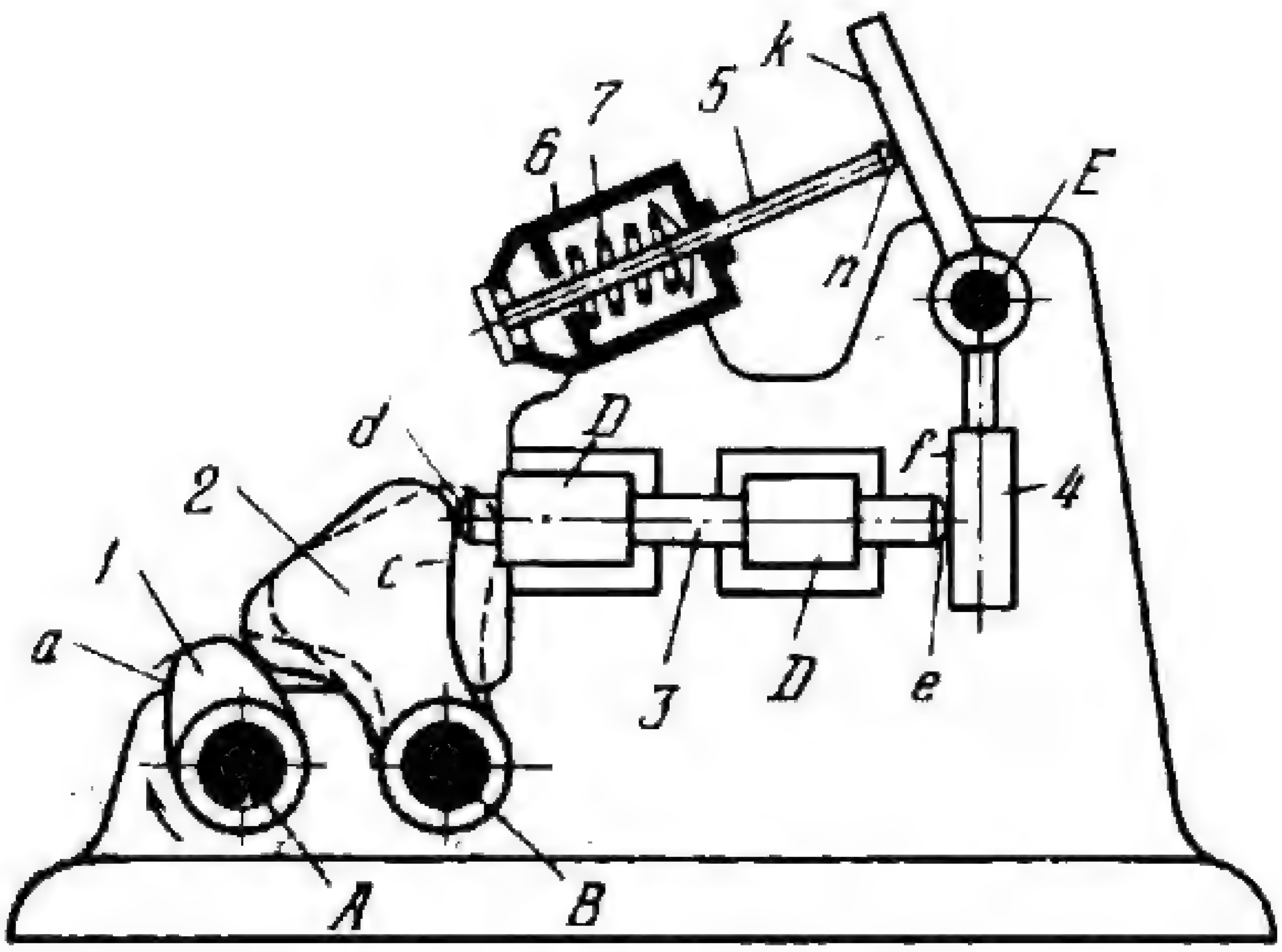


Face cam *1* has a symmetrical profiled groove *a* consisting of six identical portions and rotates about fixed axis *A*. Followers (piston rods) *4* reciprocate along fixed guides *b* and carry rollers *3* which roll and slide along groove *a*. Followers *4* are rigidly attached to pistons *2* which reciprocate in the cylinders of fixed cylinder block *5*. Positive motion is achieved because the diameter of roller *3* is equal to the width of groove *a*. The axes of the cylinders are at angles of 120° with each other.

3265	CAM-LEVER FOUR-CYLINDER PISTON MACHINE MECHANISM	CmL PM



Two-lobe cam *1* has symmetrical contour *a* made up of circular arcs and rotates about fixed axis *A*. Rollers *2*, connected by turning pairs *B*, *C*, *D* and *E* to pistons *3*, roll around contour *a* of cam *1*, reciprocating the pistons in symmetrically arranged cylinders *4*. Positive motion is achieved by links *5* which are connected together and to rollers *2* by turning pairs *B*, *C*, *D* and *E*. The lengths of the links comply with the condition: $\overline{BC} = \overline{CD} = \overline{DE} = \overline{EB}$. The axes of the cylinders make angles of 90° with one another.



Cam *1* rotates about fixed axis *A* and its contour *a* slides along the contour of cam *2* which turns about fixed axis *B*. Contour *c* of cam *2* slides along tip *d* of follower *3*, reciprocating the follower in fixed guides *D*. The other end, *e*, of follower *3* slides along flat surface *f* of link *4* which turns about fixed axis *E* so that its flat surface *k* slides along tip *n* of valve rod *5*. Rod *5* reciprocates in fixed cylinder *6*. Follower *3* is held in contact with cam *2*, and cam *2* with cam *1* by spring *7*.

14. SWITCHING, ENGAGING AND DISENGAGING MECHANISMS (3267, 3268 and 3269)

3267	CAM-LEVER SWITCHING MECHANISM	CmL SE

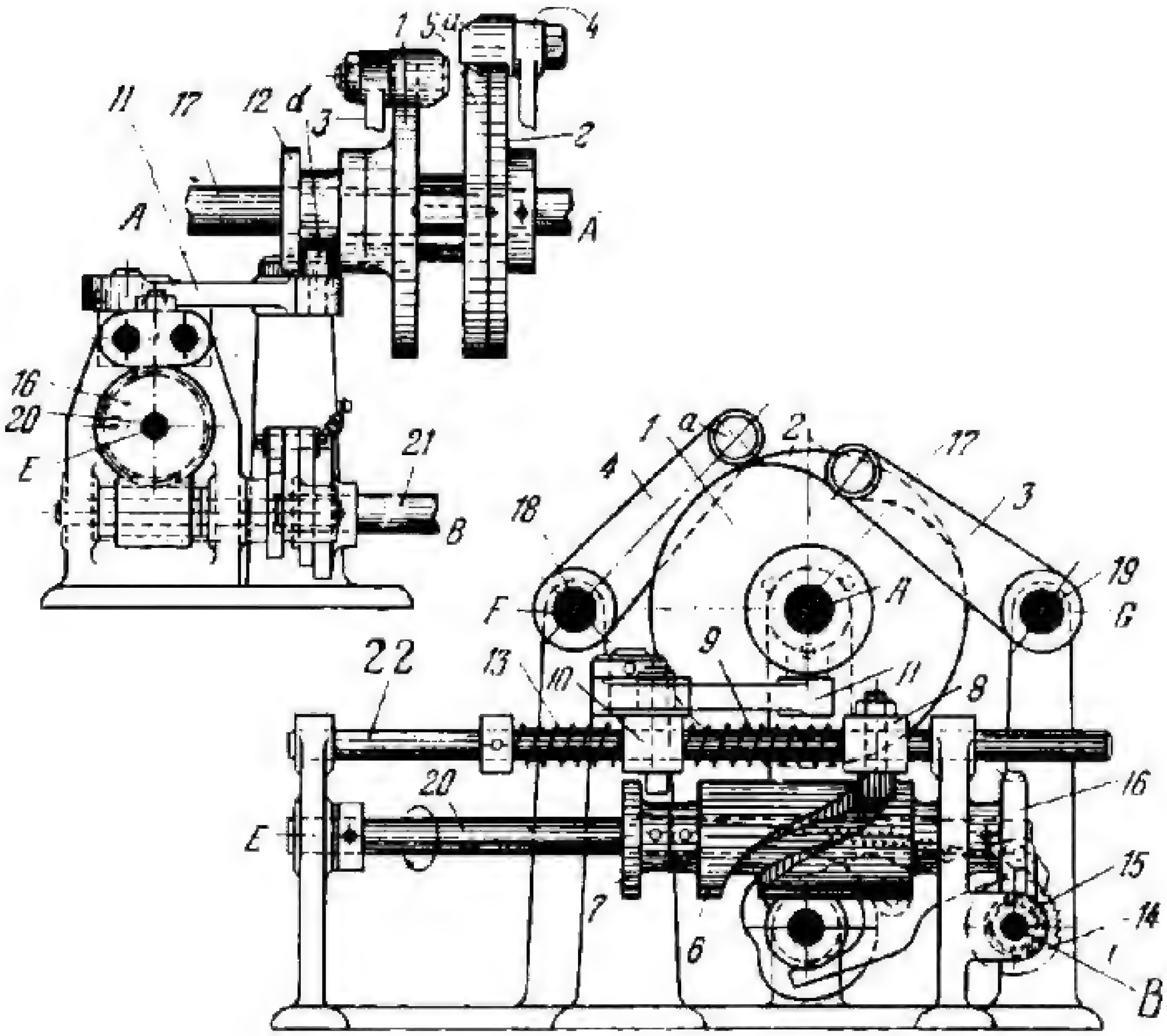
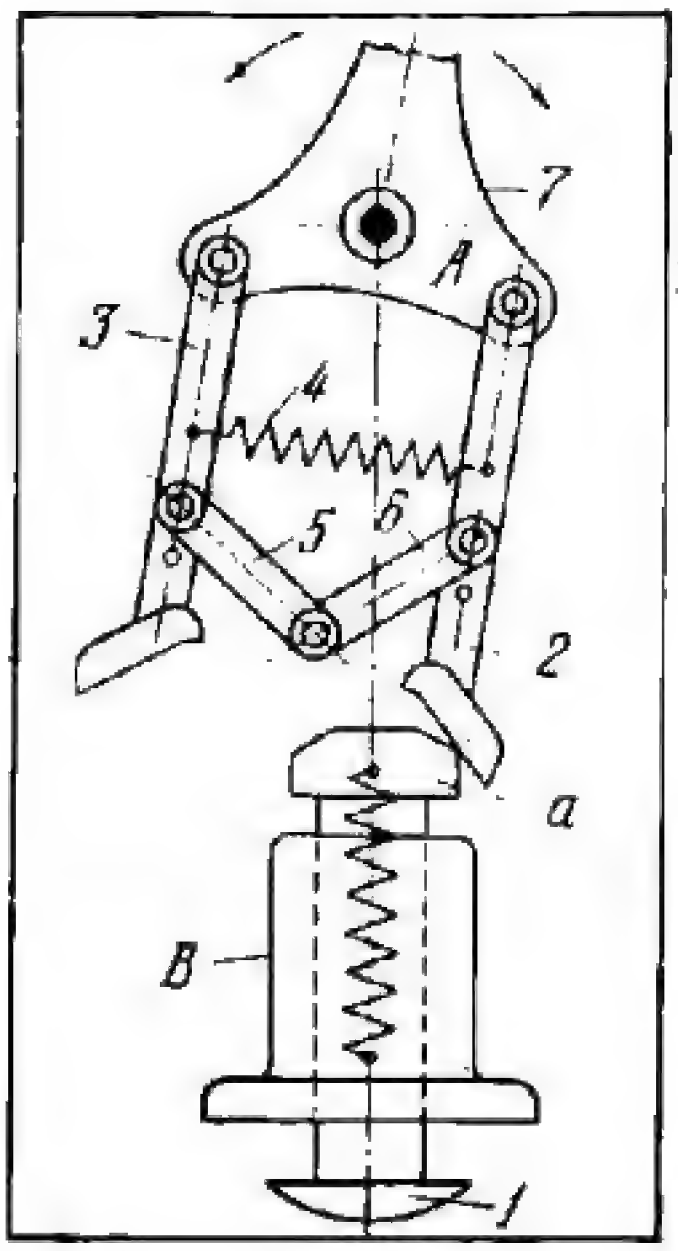


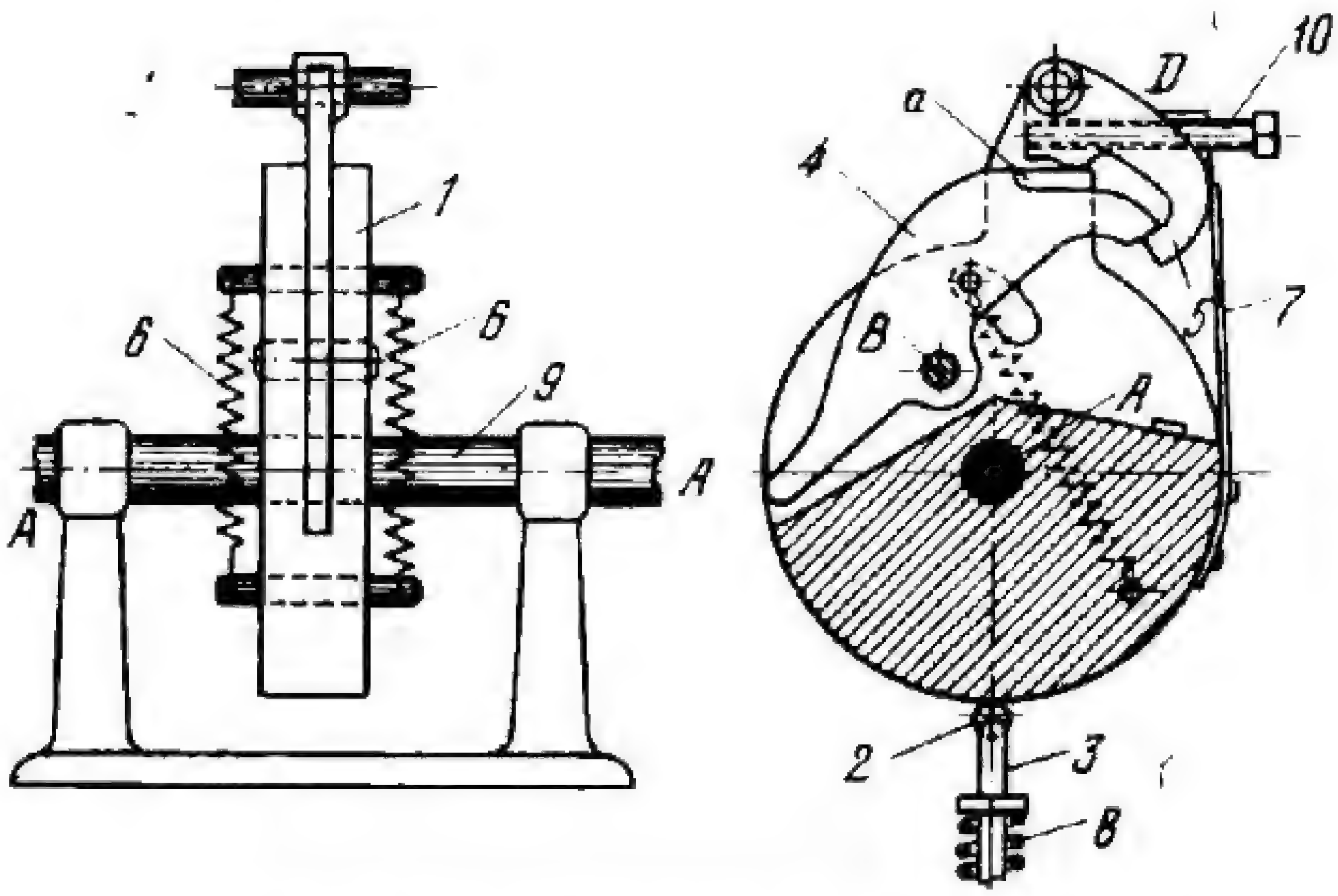
Plate cams *1* and *2*, keyed to shaft *17*, rotate about fixed axis *A* and transmit oscillating motion to either of two levers, *3* or *4*, keyed to shafts *19* and *18* which oscillate about fixed axes *G* and *F* and operate packing mechanisms (not shown). When sliding disk *5*, of the same diameter as the outside diameter of cams *1* and *2*, is in its right-hand position (as shown), roller *a* of lever *4* rides the disk without dropping into the recess of cam *2* so that shaft *18* has a dwell, but shaft *19* has its oscillating movement. Shaft *21* rotates about fixed axis *B* at the same speed as shaft *17* and, through meshing worm *15* and worm wheel *16*, drives shaft *20*, to which cylinder cam *6* and disk *7* are keyed, about fixed axis *E*. Disk *7* has two slots. As cam *6* rotates, its follower roll *8* shifts rods *22* to the left, compressing springs *9* on the rods and pressing sliding block *10* against disk *7*. When one of the slots of the disk reaches the upper position, sliding block *10* is shifted by springs *9* to the left, turning bellcrank lever *11* about a vertical axis so that pin *d* of the lever, between the flanges of sleeve *12*, shifts the sleeve and disk *5* (attached to the sleeve) to the left, adjacent to cam *1*. This engages the oscillating movement of shaft *18* and disengages that of shaft *19*. As cam *6* continues to rotate, roll *8* and rods *22* are shifted to the right, compressing springs *13*. When the second slot of disk *7* reaches its upper position, sliding block *10* is shifted by springs *13* to the right, thereby turning lever *11* so that its pin *d* shifts disk *5* back to its position adjacent to cam *2*.

CAM-LEVER PUSH-BUTTON SWITCHING MECHANISM



Push-button *1* slides in fixed guide *B* and has cam shoe *a* at its upper end. When push-button *1* is pressed, cam shoe *a* alternately engages pawls *2* and *3* which are connected together by links *6* and *5*, and by spring *4*. At this, lever *7* is switched to the corresponding position, alternately to the left and right of the vertical centre line, about fixed axis *A*, on successive strokes of push-button *1*.

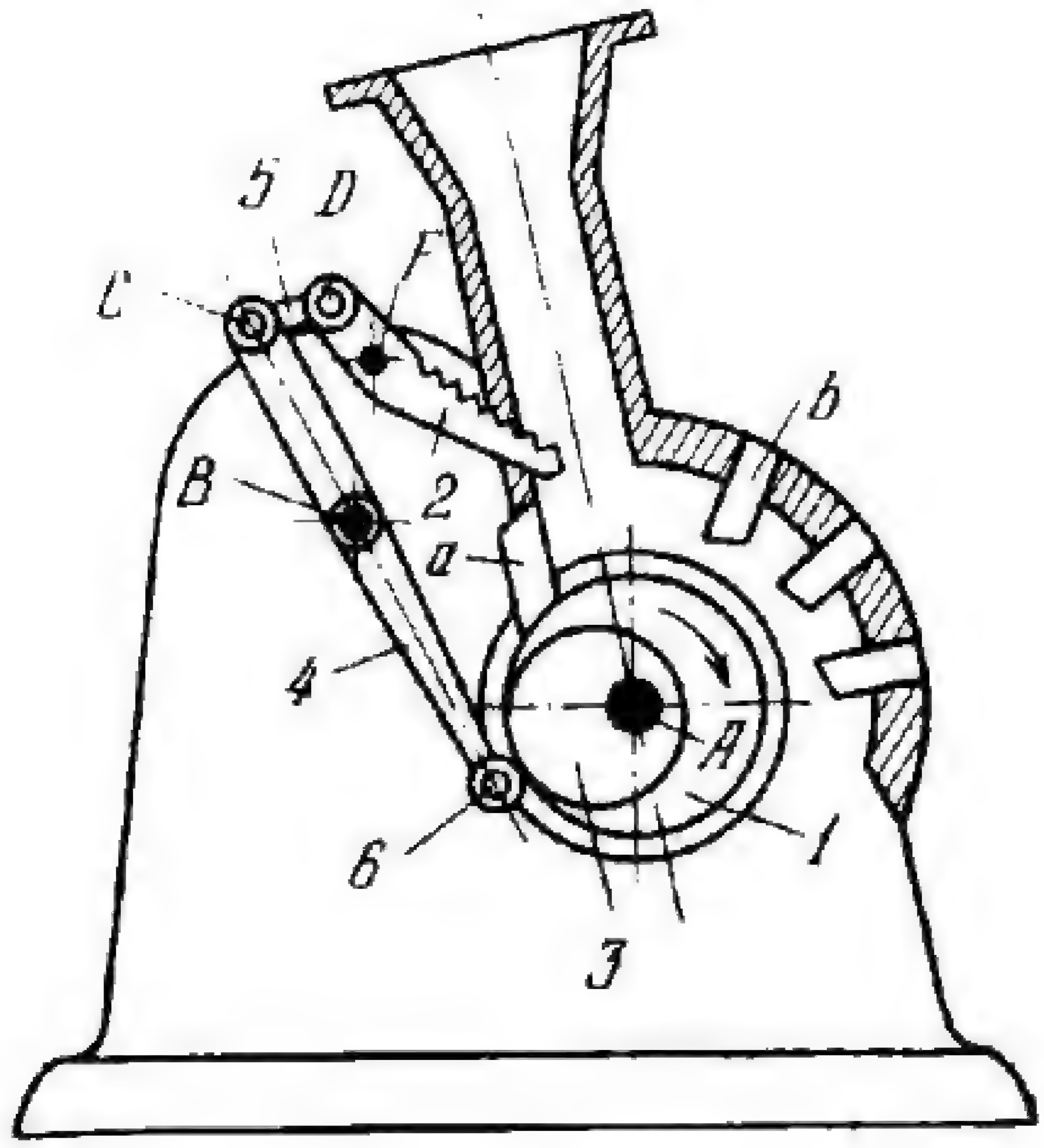
3269	CAM-LEVER QUICK-TRIPPING MECHANISM OF A CLAMPING DEVICE	CmL SE



Shaft 9 oscillates about fixed axis A about 180° in each direction. Plate cam 1, keyed to shaft 9, has flat lobe a and a slot in which cam 4 turns about axis B. When shaft 9 turns counterclockwise, roll 2 of follower 3 is gradually depressed by cam 4, slowly releasing the clamping device to which the follower is connected. When roll 2 reaches contact with lobe a, it runs against adjusting screw 10 of latch 5 and turns the latter about axis D, bending flat spring 7. This releases cam 4 which is turned by springs 6 clockwise about axis B to its lower position. At this point, shaft 9 reverses and, in clockwise rotation of the cam assembly, roll 2 reaches the end of lobe a and is returned suddenly by spring 8 into contact with the concentric portion of cam 1, so that follower 3 quickly engages the clamping device. As cam 1 continues to turn clockwise, roll 2 contacts the protruding end of cam 4, turning it counterclockwise about axis B by overcoming the resistance of springs 6 until it is returned to its initial position in which it is held by latch 5 and spring 7.

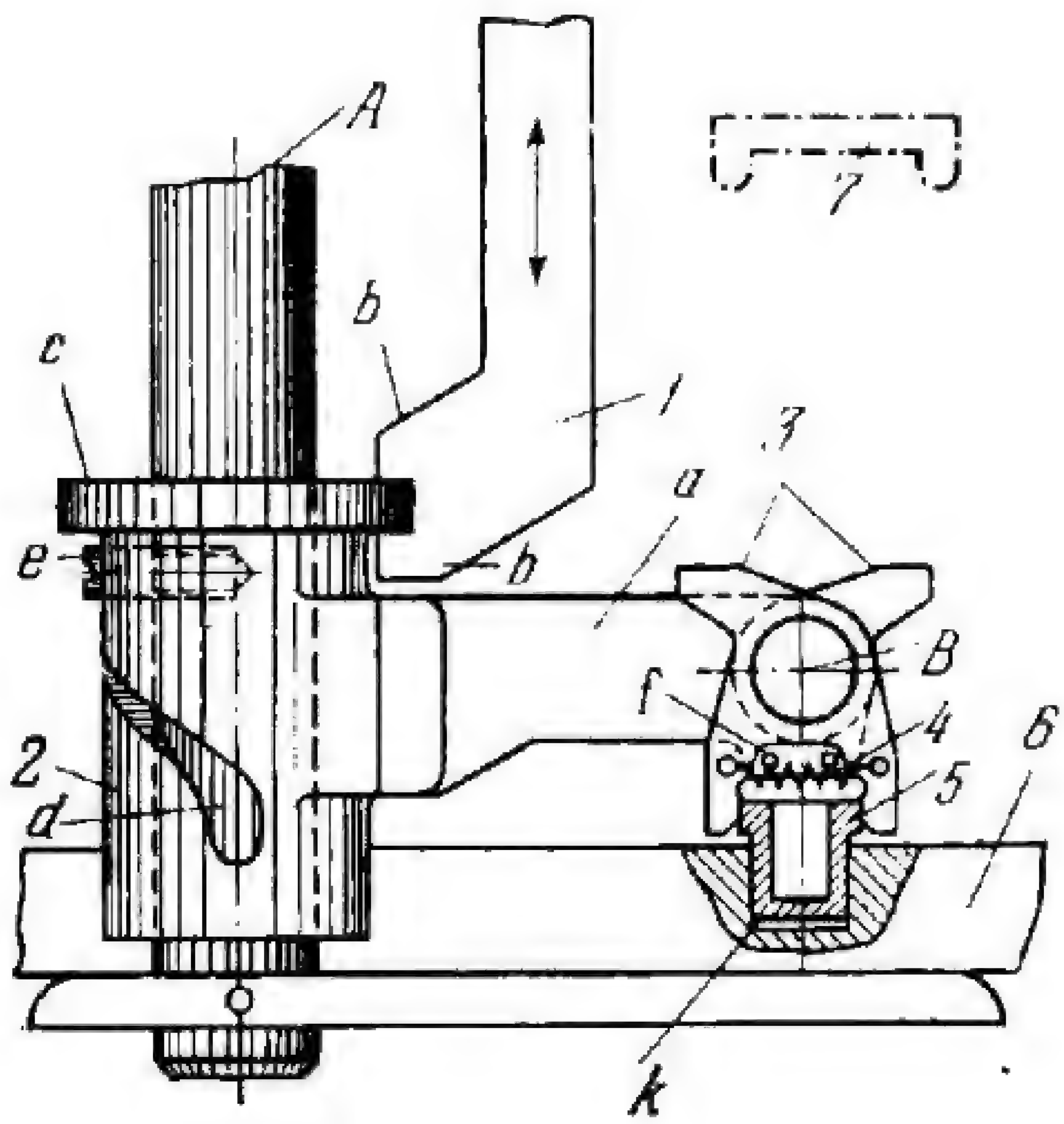
15. MECHANISMS OF OTHER FUNCTIONAL DEVICES
(3270 through 3297)

3270	ECCENTRIC-LEVER MECHANISM OF A WOOD-CHIPPING MACHINE	CmL FD



Rotor *1* rotates about fixed axis *A* with rigidly attached round eccentric *3*. Follower *4* oscillates about fixed axis *B* and carries roll *6* which rolls along the contour of eccentric *3*. Link *5* is connected by turning pairs *C* and *D* to follower *4* and to link *2* which oscillates about fixed axis *F*. As rotor *1* rotates, wood is fed in by link *2* and is cut up into chips by rotary knife *a*, mounted on rotor *1*, and stationary knives *b*, mounted in the fixed housing.

3271	CAM-LEVER SPATIAL EJECTING MECHANISM	CmL FD



Bracket *1*, secured to the press ram, engages flange *c* of cam bushing *2* with its lugs *b*. Bushing *2* has helical cam groove *d* and can slide along and turn about fixed post *A*. Pin *e*, secured in the post, engages groove *d* of bushing *2*. Spring fingers *3*, pivoted to swinging arm *a* of bushing *2*, grip workpiece *5*. When the press ram with bracket *1* travels upward, fingers *3* lift workpiece *5* out of hole *k* in dial *6* of the press and then, as pin *e* slides in the angular part of cam groove *d*, bushing *2* and arm *a* are swung to carry workpiece *5* over the edge of dial *6*. At this point, the top ends of fingers *3* contact fixed stop *7*, opening the fingers and releasing the workpiece which drops into a chute. Spring *4* imparts the required gripping pressure to fingers *3*. Centralizing pins *f* are provided to locate fingers *3* correctly over the workpiece when the press ram and bracket *1* travel downward.

3272	CAM-LEVER MECHANISM OF A TRIMMING MACHINE	CmL FD

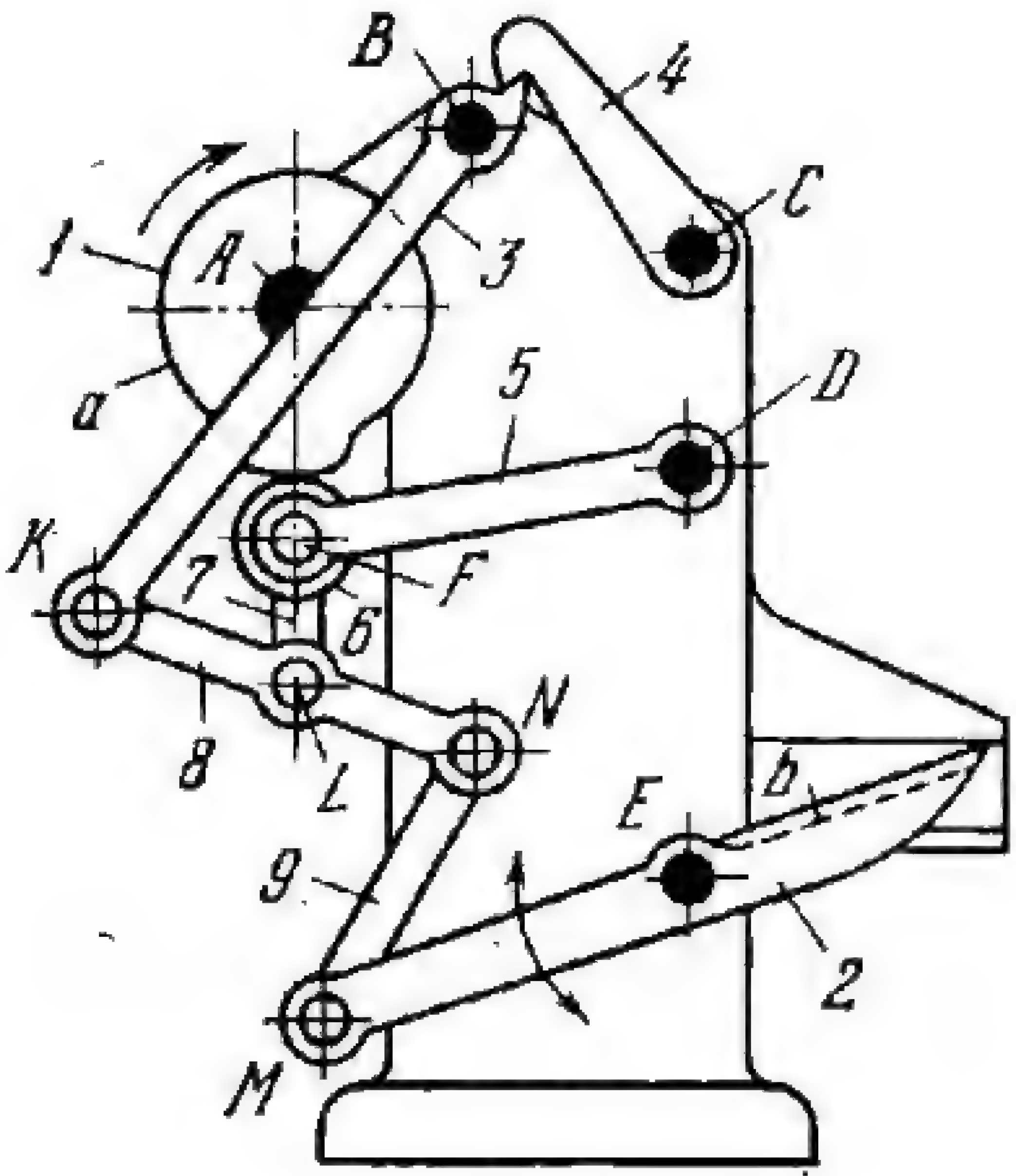


Plate cam *1* rotates about fixed axis *A*. Follower *5* turns about fixed axis *D* and carries roller *6* which rolls along contour *a* of cam *1*. Link *7* is connected by turning pairs *F* and *L* to follower *5* and link *8*. Link *9* is connected by turning pairs *N* and *M* to links *8* and *2*. Link *2* carries knife *b* and turns about fixed axis *E*. Link *8* is connected by turning pair *K* to link *3* which can turn about fixed axis *B*. Latch *4* turns about fixed axis *C* and can lock link *3*. Link *2* with knife *b* oscillates only when link *3* is locked (as shown). If latch *4* is turned away to release link *3*, cam *1* has idle rotation.

3273	**CAM-LEVER MECHANISM OF AN INKING ROLLER DRIVE**	CmL FD

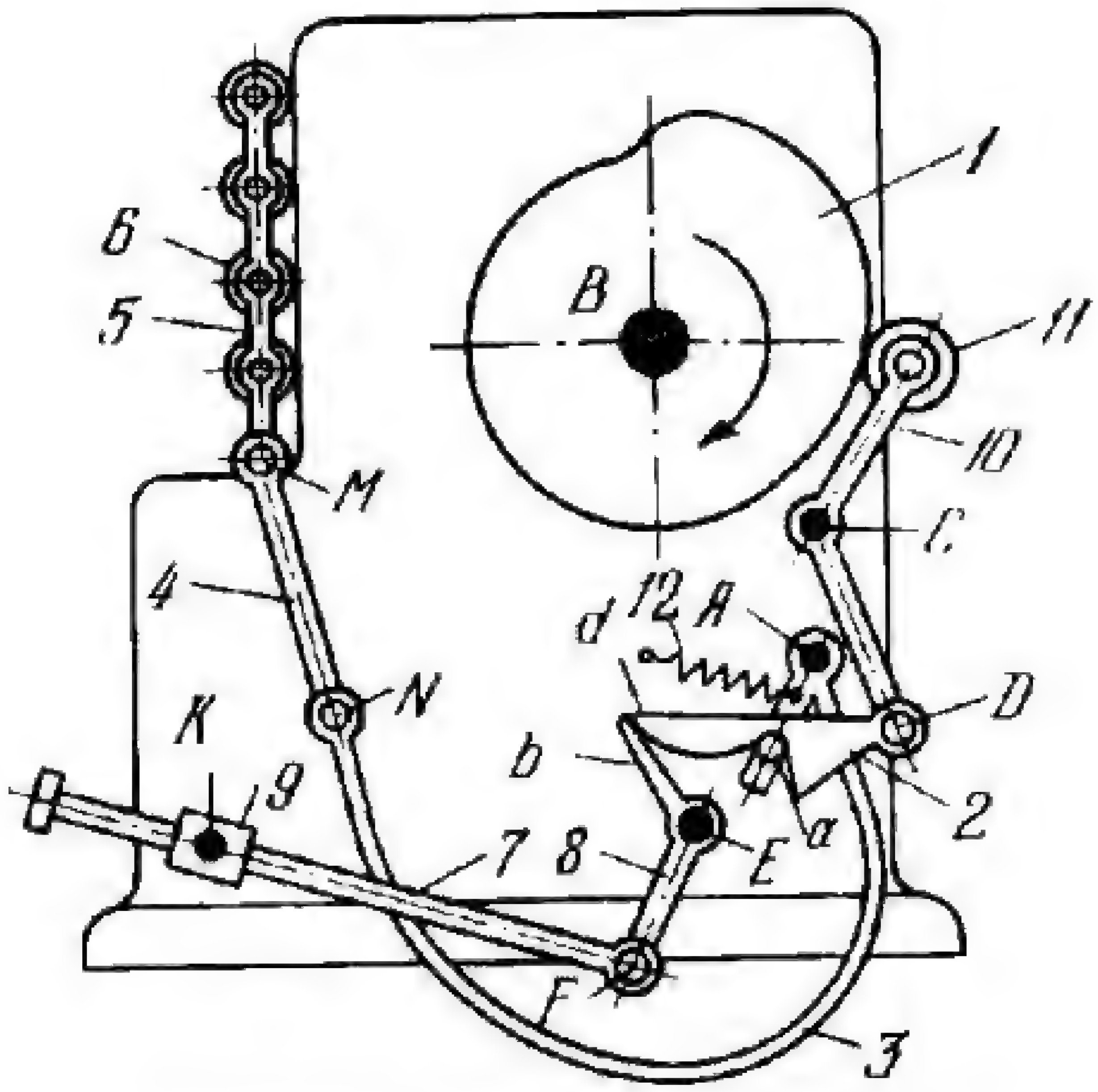


Plate cam *1* rotates about fixed axis *B*. Follower *10* turns about fixed axis *C* and carries roller *11* which rolls along the contour of cam *1*. Follower *10* is connected by turning pair *D* to hook member *2* whose lug *d* slides along arm *b* of lever *8*. Lever *8* turns about fixed axis *E* and is connected by turning pair *F* to link *7* which, in turn, is connected by a sliding pair to slider *9*. Slider *9* turns about fixed axis *K*. From cam *1*, keyed to the main shaft, motion is transmitted to hook member *2* which engages pin *a* of lever *3*. Lever *3* oscillates about fixed axis *A*. By means of connecting link *4*, connected by turning pairs *N* and *M* to lever *3* and to inking carriage *5*, motion is transmitted to carriage *5* which carries inking rollers *6*. To engage the inking motion, link *7* is pushed to the right so that it slides and turns in slider *9*. This turns lever *8*, allowing member *2* to engage pin *a* of lever *3*. Carriage *5* with inking rollers *6* is pushed upward by the action of spring *12* on lever *3*, and is pulled downward by cam *1*. When link *7* is pulled to the left, arm *b* of lever *8* raises member *2* disengaging it from pin *a* of lever *3* so that inking carriage *5* stops in its upper position.

3274	CAM-LEVER MECHANISM FOR ACTUATING SUCTION CUPS	CmL FD

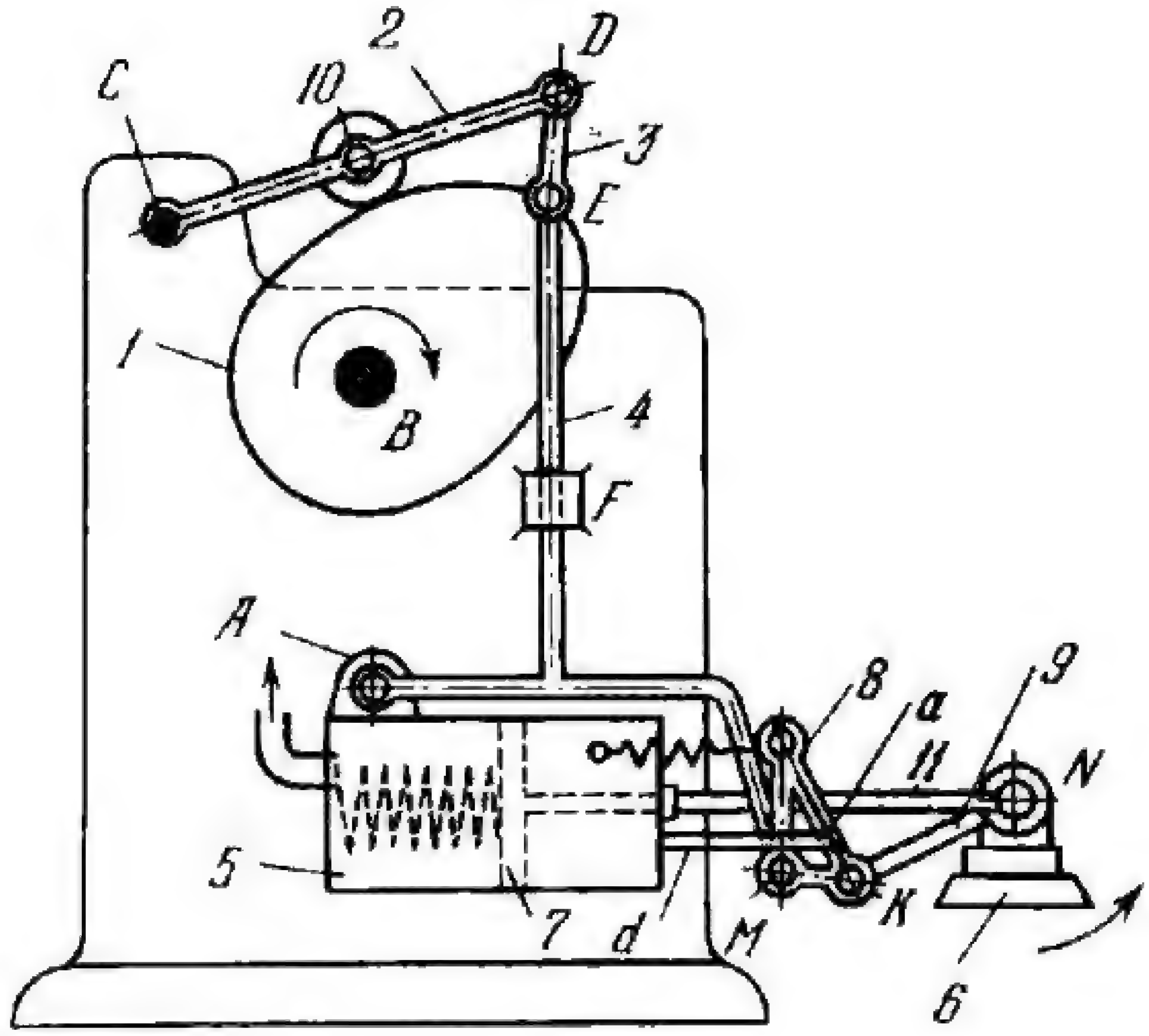
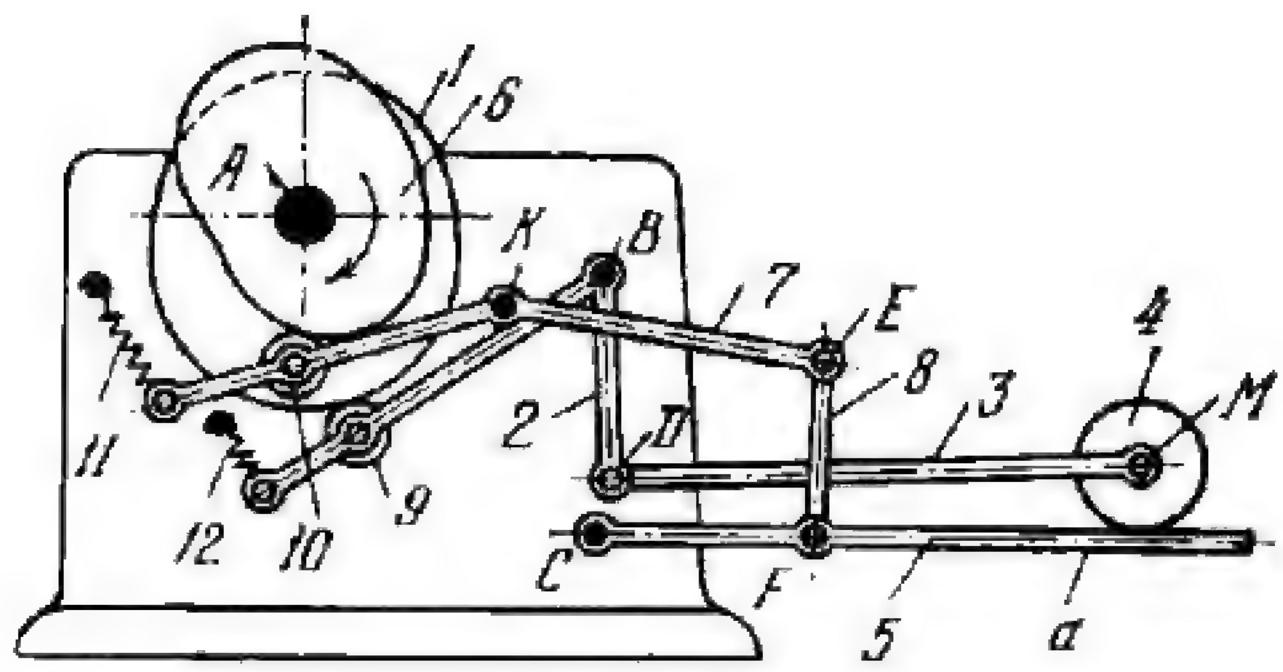


Plate cam *1* rotates about fixed axis *B*. Follower *2* turns about fixed axis *C* and carries roller *10* which rolls along the contour of cam *1*. Link *3* is connected by turning pairs *D* and *E* to follower *2* and to link *4* which reciprocates in fixed guide *F*. Vacuum cylinder *5* is connected by turning pair *A* to link *4* and contains piston *7* whose rod *11* is connected by turning pair *N* to suction cup *6*. Link *9*, rigidly attached to suction cup *6*, is connected by turning pair *K* to link *8* which, in turn, is connected by turning pair *M* to link *4*. When suction cups *6* are lowered to the sheets of paper, the vacuum pump is engaged and piston *7* travels to the left so that lug *a* on link *8* runs up against lug *d* on the cylinder. This causes link *8* to turn about axis *M*, turning link *9* and suction cup *6* about axis *N* and thereby bending over the edge of the sheet of paper.

3275	CAM-LEVER MECHANISM FOR ACTUATING SUCTION CUPS	CmL FD



Rigidly attached plate cams *1* and *6* rotate about fixed axis *A*. Followers *2* and *7* turn about fixed axes *B* and *K* and carry rollers *9* and *10* that roll along the contours of cams *1* and *6*. Link *8* is connected by turning pairs *E* and *F* to follower *7* and to link *5* which turns about fixed axis *C*. Link *3* is connected by turning pairs *D* and *M* to follower *2* and to roller *4*. Springs *11* and *12* hold rollers *10* and *9* against cams *6* and *1*. Motion is transmitted from cam *1* to roller *4* on whose axis the suction cup is mounted. Roller *4* travels along oscillating guide *a* of link *5*.

3276	CAM-LEVER MECHANISM OF A LOOM	CmL FD

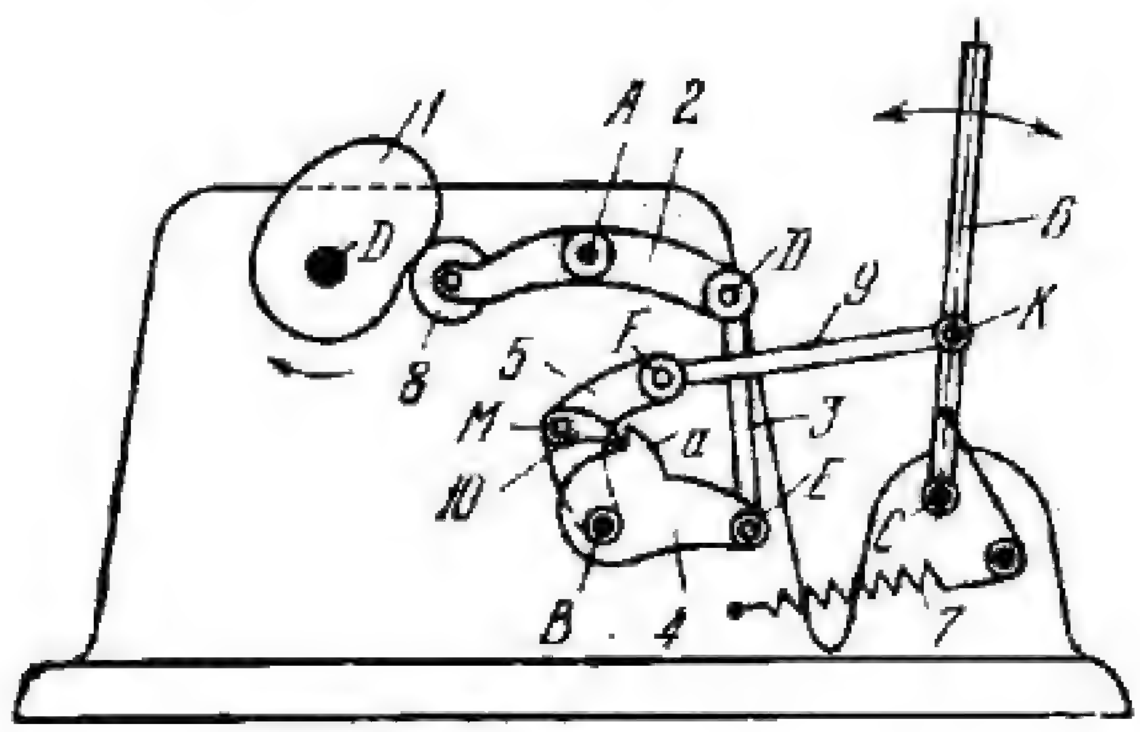
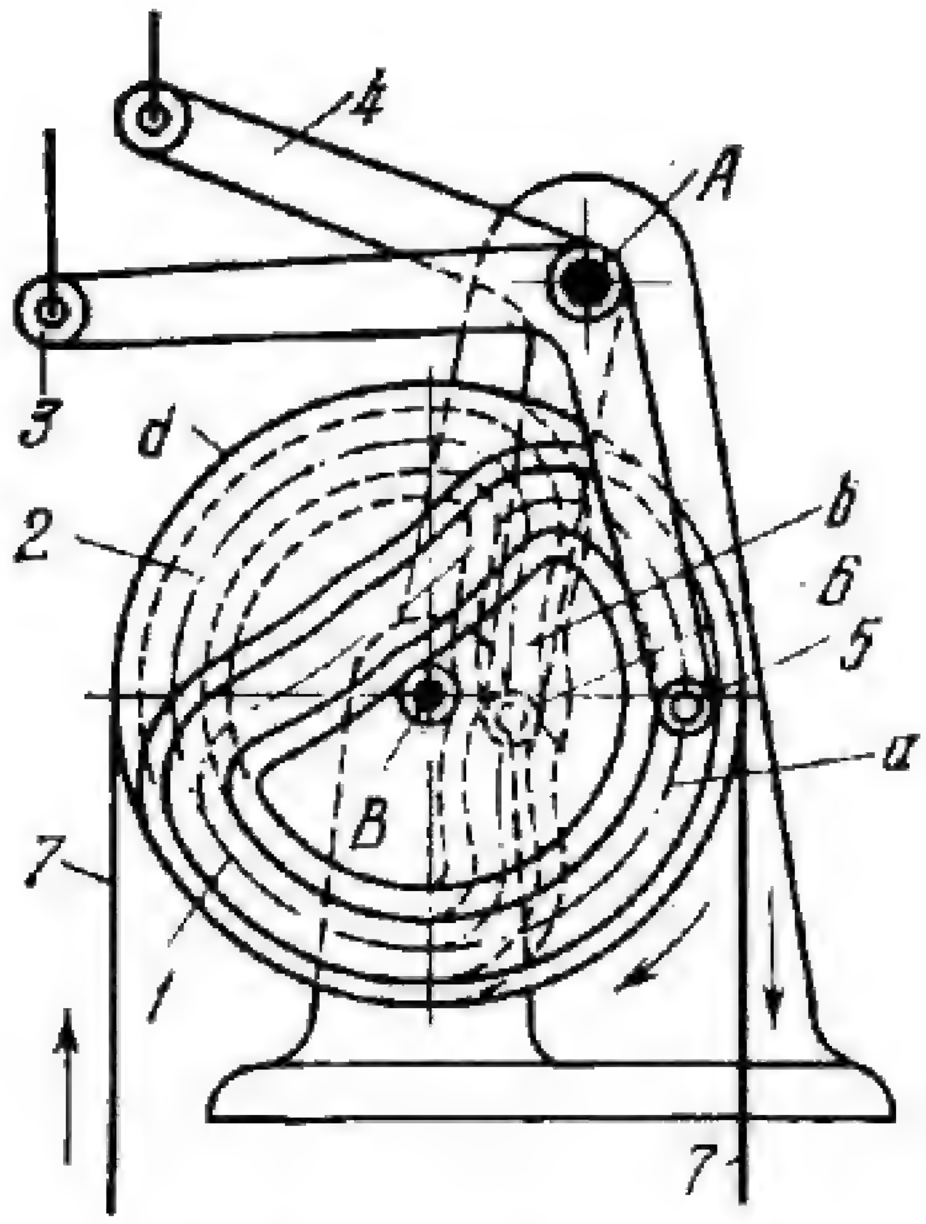


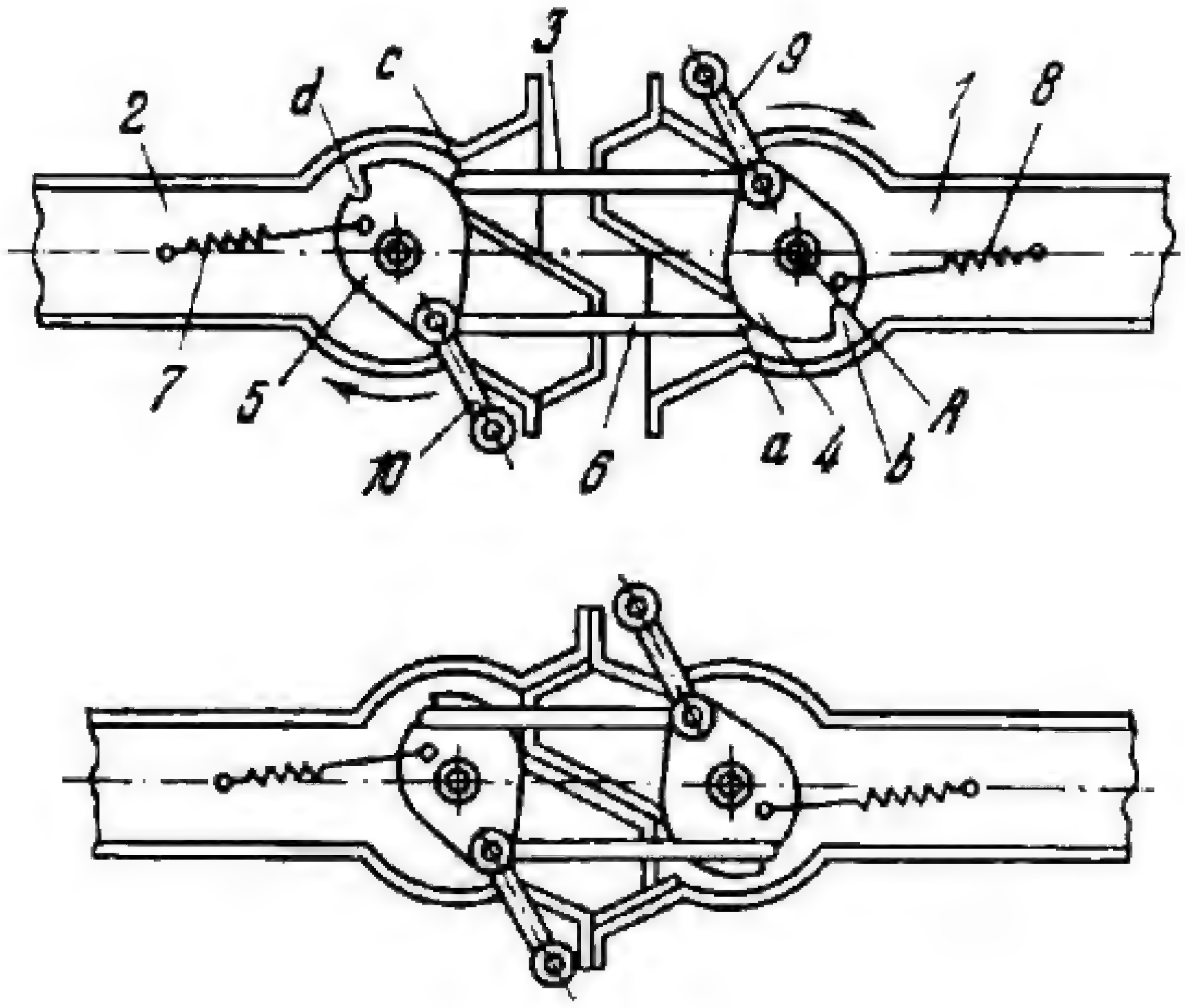
Plate cam *1* rotates about fixed axis *D*. Follower *2* turns about fixed axis *A* and carries roller *8* which rolls along the contour of cam *1*. Link *3* is connected by turning pairs *D* and *E* to follower *2* and to link *4* which turns about fixed axis *B*. Link *9* is connected by turning pairs *K* and *F* to slay *6*, turning about fixed axis *C*, and to link *5*, turning about axis *B*. When cam *1* rotates, lug *a* of link *4* engages pawl *10*, which turns about axis *M* of link *5*, and, by means of link *9*, turns slay *6* about axis *C*. The slay is returned to its initial position by spring *7*.

3277	CAM-LEVER SEMAPHORE CONTROL MECHANISM	CmL FD



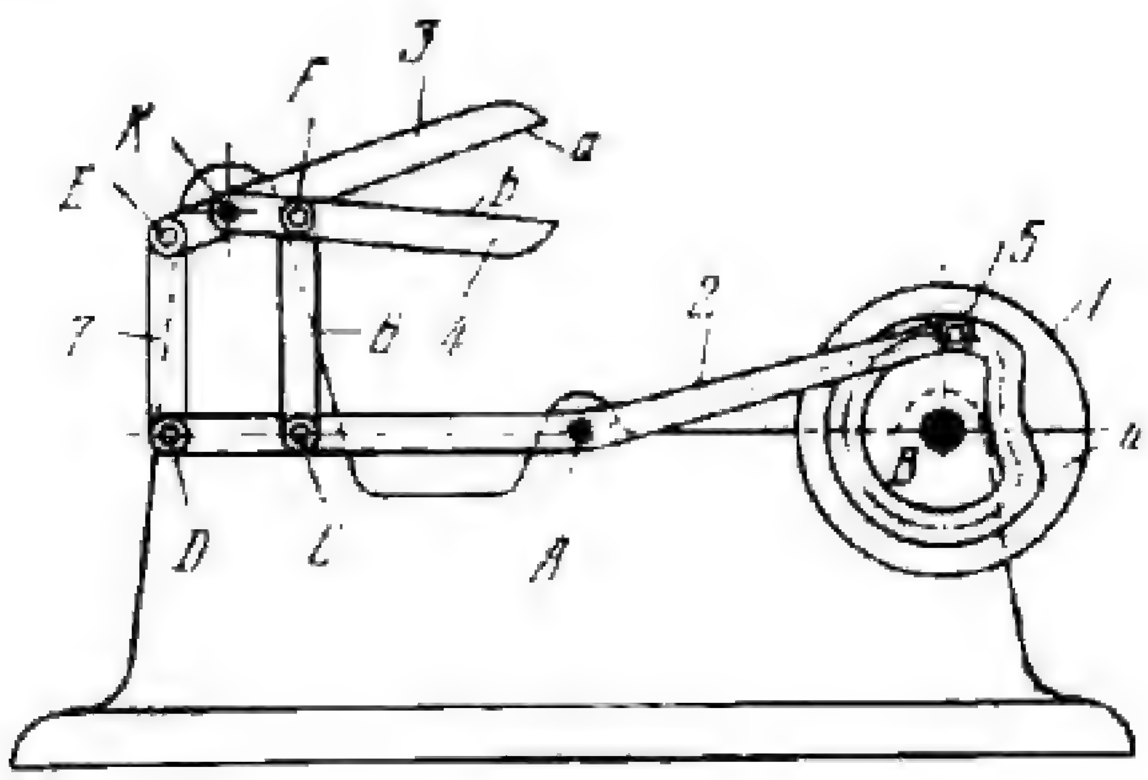
Rigidly attached face cams *1* and *2* turn about fixed axis *B* and have profiled grooves *a* and *b*. Followers *3* and *4* turn about fixed axis *A* and carry rollers *5* and *6* which roll and slide along grooves *a* and *b*. The cams are turned by flexible link *7* which runs over pulley *d*, rigidly attached to the cams. When cams *1* and *2* turn, followers (levers) *3* and *4* are turned about axis *A* and operate the two-arm semaphore.

3278	CAM-LEVER AUTOMATIC COUPLER MECHANISM	CmL FD



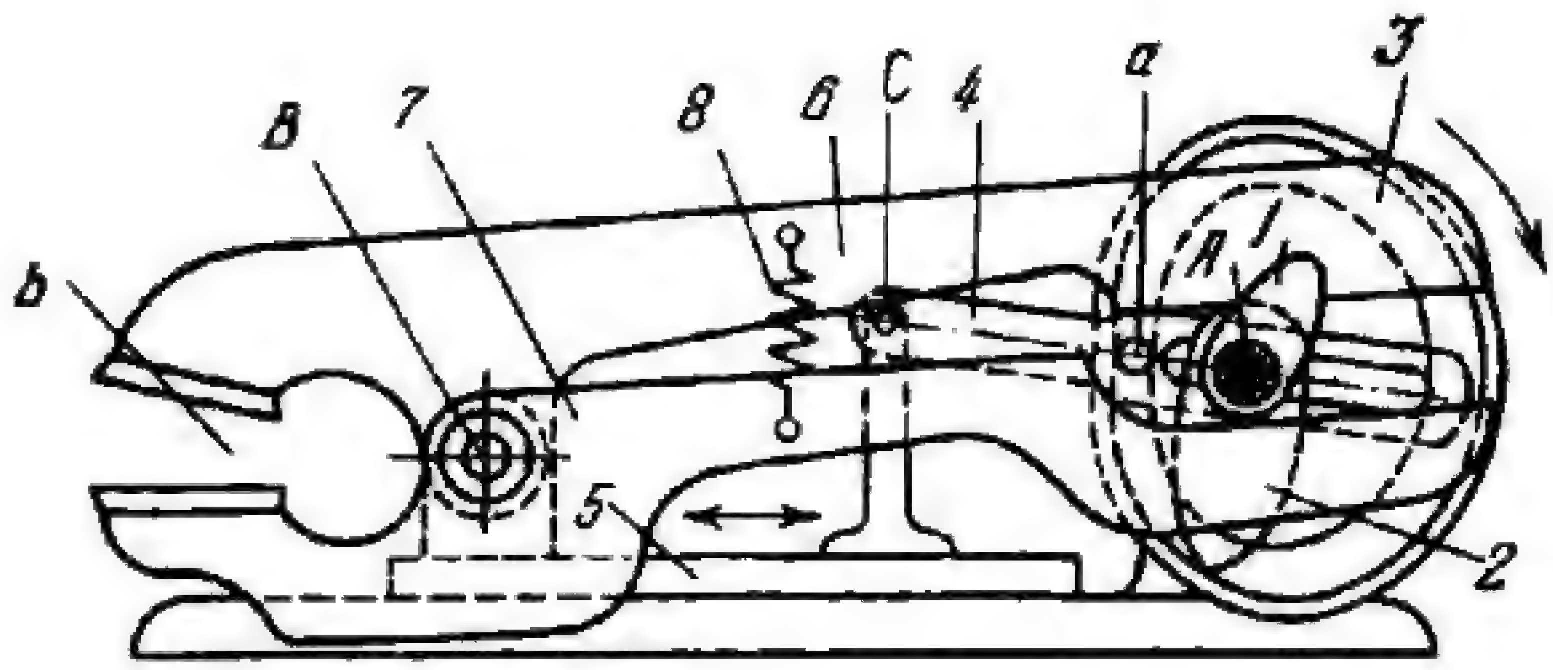
As links *1* and *2* approach each other (upper view), cam *5* causes lever *3* to turn cam *4* clockwise until latch *a* at the end of lever *6* enters recess *b* of cam *4*. At the same time, latch *c* at the end of lever *3*, operating in the same way as lever *6*, enters recess *d* of cam *5*. Cams *4* and *5* are returned to the initial (uncoupled) position by springs *8* and *7* when levers *3* and *6* are disengaged by turning handles *9* and *10* which are rigidly attached to (or integral with) the levers. The lower view shows the coupled position.

3279	**CAM-LEVER SHEARING MECHANISM OF A CANDY-WRAPPING MACHINE**	**CmL** **FD**



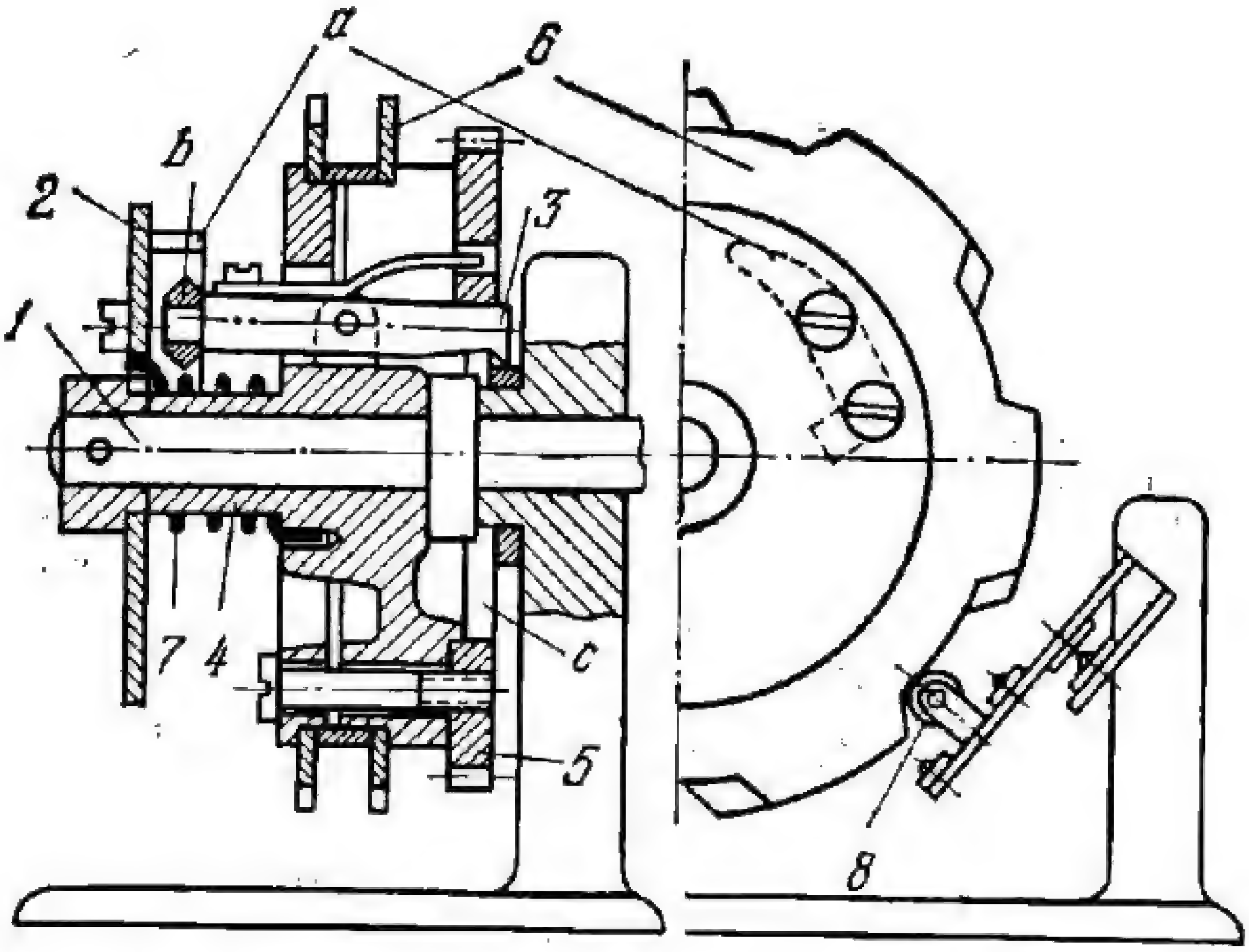
Face cam *1* rotates about fixed axis *B* and has profiled groove *a*. Follower *2* turns about fixed axis *A* and carries roller *5* which rolls and slides along groove *a*. Links *6* and *7* are connected by turning pairs *C* and *D* to follower *2* and by turning pairs *F* and *E* to knives *4* and *3* which turn about fixed axis *K*. The lengths of the links comply with the conditions: $\overline{ED} = \overline{FC}$ and $\overline{KE} = \overline{KF}$. When cam *1* rotates, follower *2* oscillates, opening and closing blades *a* and *b* of knives *3* and *4*.

3280	**CAM-LEVER RECIPROCATING SHEAR MECHANISM**	**CmL** **FD**



Rigidly attached plate cams *1* and *2* and face cam *3* rotate about fixed axis *A*. The groove of cam *3*, acting on roller *a* of slotted link *4*, reciprocates slide *5*, to which link *4* is connected by turning pair *C*, horizontally along the base. Cams *1* and *2* actuate the ends of levers *6* and *7*, oscillating them about axis *B* of slide *5* so that blades *b* at the other end of levers *6* and *7* operate as a shear. The slot of link *4* slides along shaft *A* of the cams. Spring *8* holds levers *6* and *7* in contact with cams *1* and *2*.

3281	CAM-LEVER MECHANISM OF A WATER LEVEL REMOTE-INDICATING INSTRUMENT	CmL FD



Shaft *1* is turned by a device (not shown) connected to a float whose position depends upon the water level in a reservoir or tank. Shaft *1* turns disk *2* which has curvilinear cam surface *a* and depresses roller *b* at the end of pawl *3*. This turns pawl *3* so that its tip is withdrawn from recess *c*. At this, sleeve *4* and wheel *5* are turned by spring *7* together with cam disk *6*, rigidly mounted on sleeve *4*, so that a lobe of disk *6* closes electric contact *8*.

3282	CAM-LEVER MECHANISM OF A PAPER PRESS	CmL FD

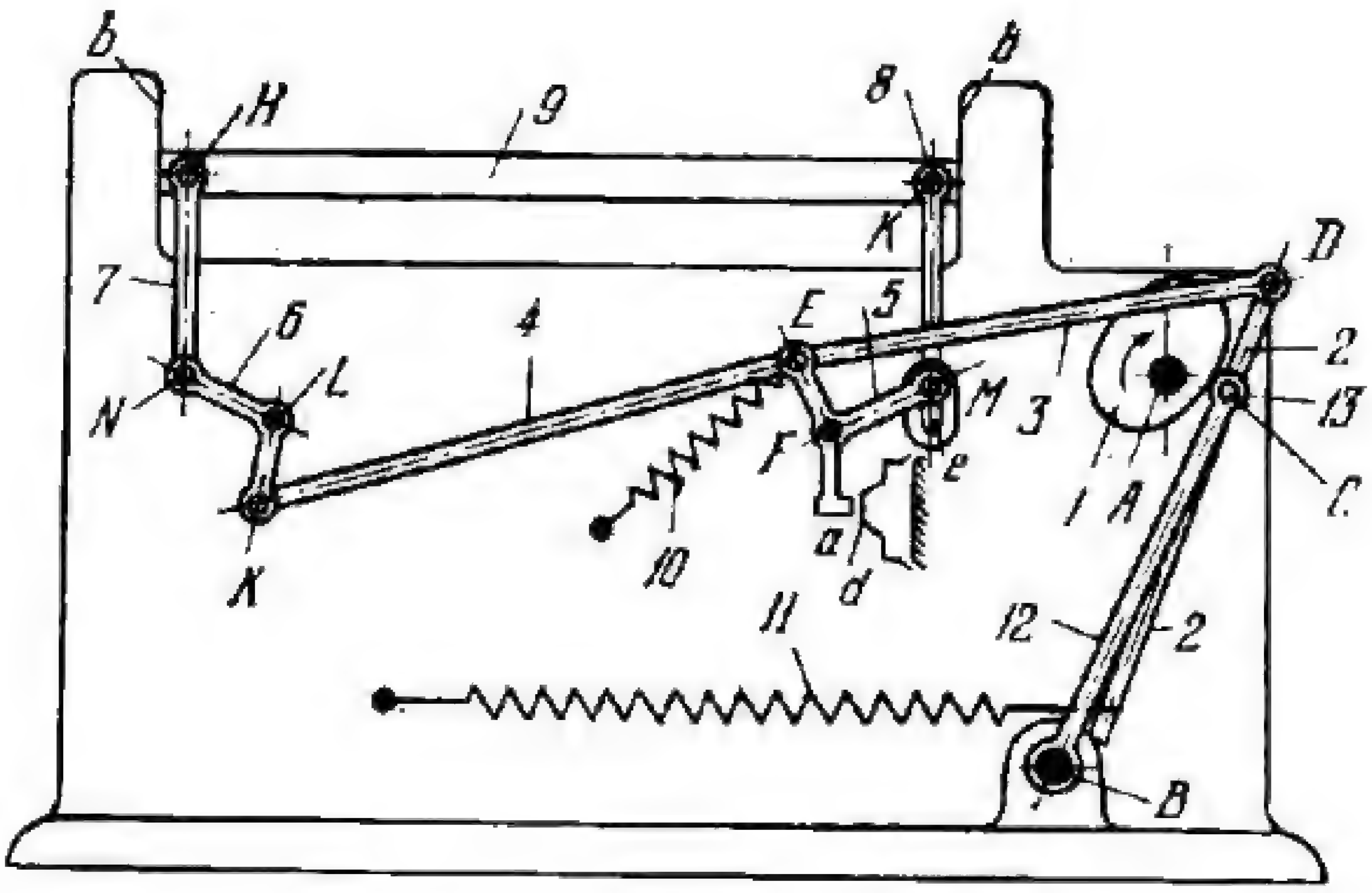
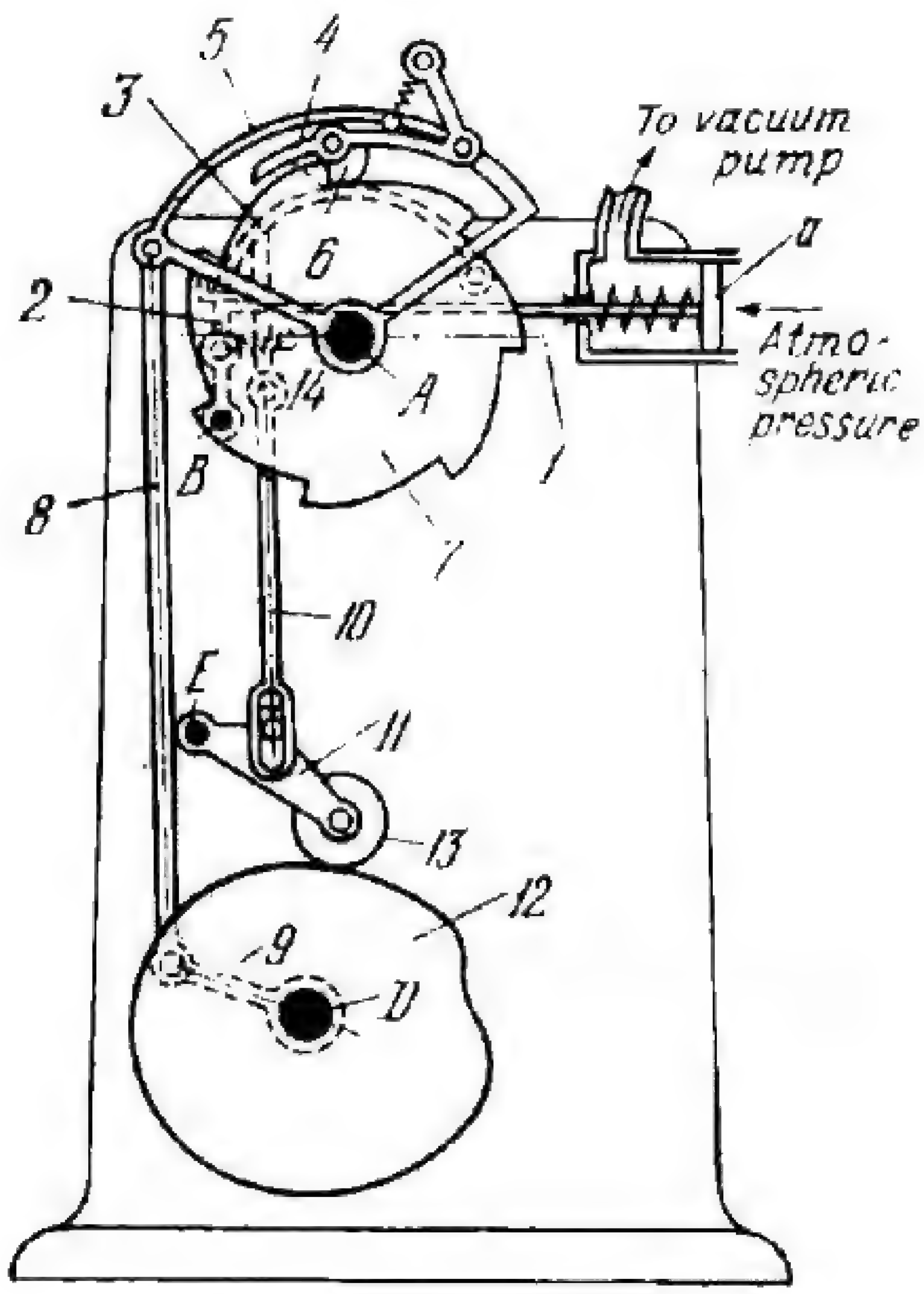


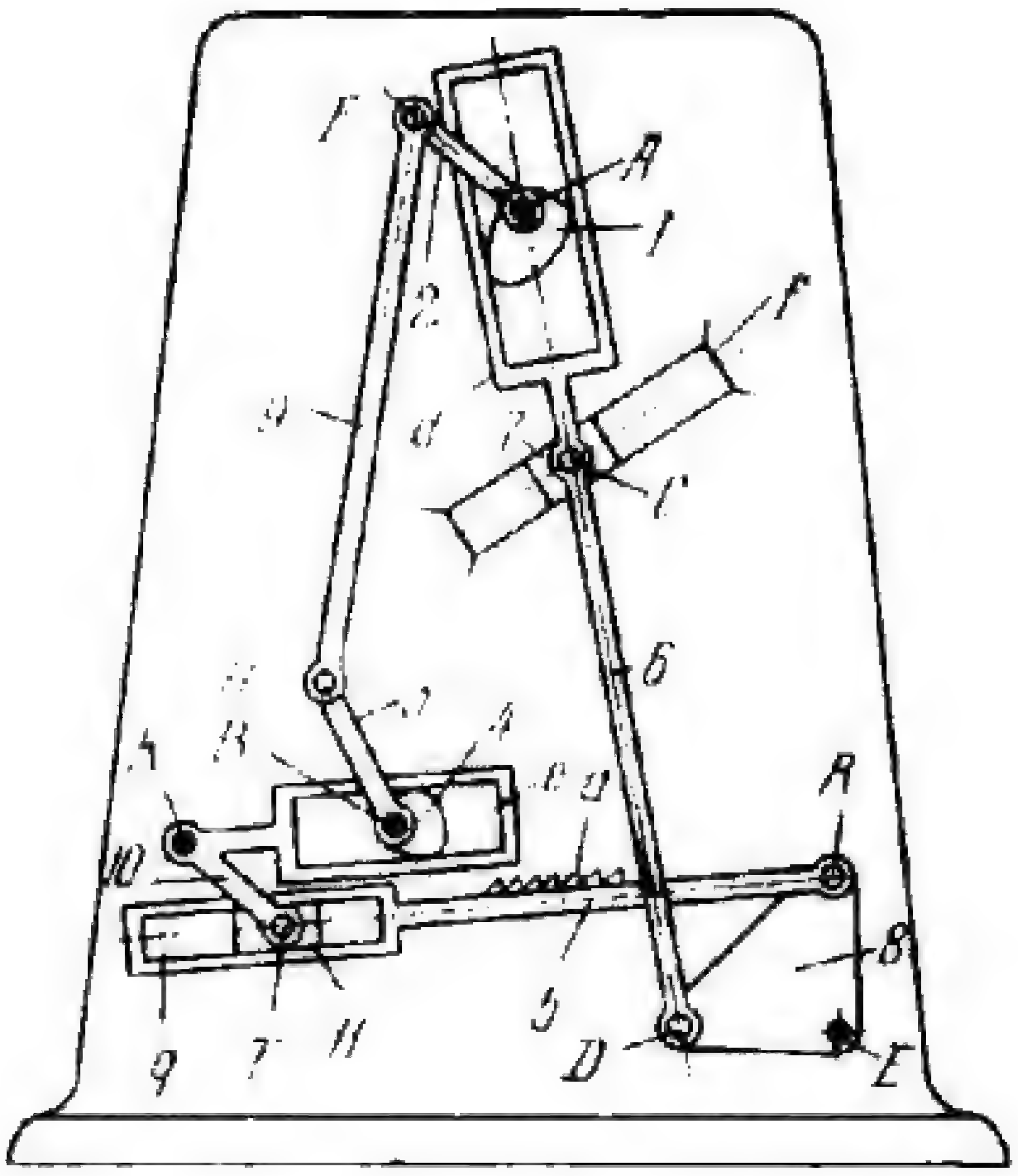
Plate cam *1* rotates about fixed axis *A*. Follower *12* oscillates about fixed axis *B* and carries roller *13* which rolls along the contour of cam *1*. Link *2* is connected by turning pair *C* to link *12* and, at its lower end, is acted on by spring *11* which holds roller *13* in contact with cam *1*. Link *3* is connected by turning pairs *D* and *E* to links *2* and *5*. Link *5* turns about fixed axis *F* and is subject to the tension of spring *10*. Link *4* is connected by turning pairs *E* and *K* to link *5* and to link *6* which turns about fixed axis *L*. Slide *9* reciprocates vertically in fixed guides *b-b*. Link *7* is connected by turning pairs *N* and *H* to link *6* and to slide *9*. Link *8* is connected by turning pair *K* to slide *9* and its slot *e* slides along pin *M* of link *5*. Motion is transmitted from cam *1* through links *2* and *12*, and further to links *5* and *6*. When links *3* and *4* travel to the right, links *5* and *6* are turned, one clockwise and the other counterclockwise, so that links *8* and *7* pull slide *9* downward. Slide *9* is returned to its upper position by spring *10*. Lug *a* of link *5* runs against fixed stop *d* to restrict the upward motion of slide *9*.

3283	CAM-LEVER PAPER FEED MECHANISM	CmL FD



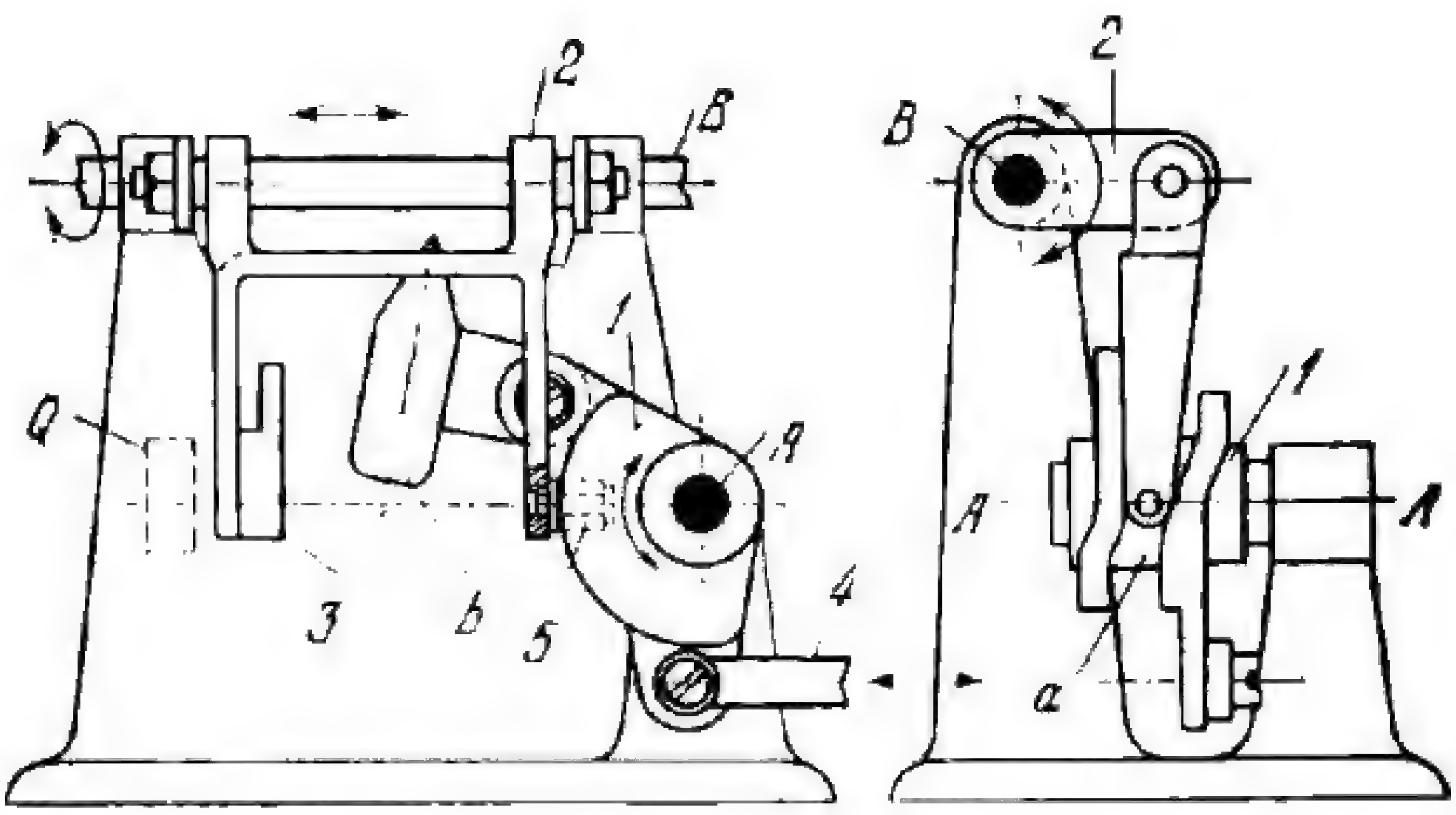
When the vacuum pump is switched on, piston *a* in the vacuum cylinder begins to travel to the left due to atmospheric pressure. Piston rod *1* turns link *2* counterclockwise about fixed axis *B*. At this, shaped link *3* drops and pawl *4*, pivoted to link *5* and resting with its roller *6* on link *3*, engages and turns ratchet wheel *7* together with its shaft *A*. This shaft transmits motion to a platform with a stack of paper, raising the platform. Link *5* is oscillated about shaft *A* by crank *9* through connecting rod *8*. Link *3* is returned to its upper position by links *10* and *11* which are actuated by cam *12*, keyed on main shaft *D* of the stacker and rotating about a fixed axis. Follower *11* turns about fixed axis *E* and carries roller *13* which rolls along the contour of cam *12*. Spring *14* tends to hold link *2* in the vertical position.

3284	**CAM-LEVER CLOTH ADVANCER MECHANISM OF A SEWING MACHINE**	CmL FD



Rigidly attached constant-breadth cam *1* and crank *2* rotate about fixed axis *A*. Cam *1* is confined in yoke *d* of link *6* which is connected by turning pairs *C* and *D* to slider *7* and to link *8*. Slider *7* moves along fixed guide *f* and link *8* turns about fixed axis *E*. Link *9* is connected by turning pairs *F* and *H* to crank *2* and to crank *3* which is rigidly attached to constant-breadth cam *4* and turns about fixed axis *B*. Cam *4* is confined in yoke *e* of link *10* which turns about fixed axis *K* and is connected by turning pair *T* to slider *11*. Slider *11* moves along slot *q* of link *5* which is connected by turning pair *R* to link *8*. When cam *1* rotates about axis *A*, serrated member *a*, mounted on link *5*, grips and advances the cloth being sewn.

3285	CAM-LEVER SPATIAL CLOTH ADVANCER MECHANISM OF A SEWING MACHINE	CmL FD



Cylinder cam *1* is oscillated by link *4* about fixed axis *A*. Roller *5* of link *2* rolls and slides along groove *a* of cam *1*. The profile of groove *a* provides for oscillation of link *2* about fixed axis *B* and its reciprocation along this axis. In this motion, member *3*, which grips the cloth, has a motion whose path *Q* is shown in the left-hand view. Positive motion is achieved by the action of weight *b*.

3286	CAM-LEVER INK-TRANSFER ROLLER MECHANISM OF A FLAT-BED PRINTING PRESS	CmL FD

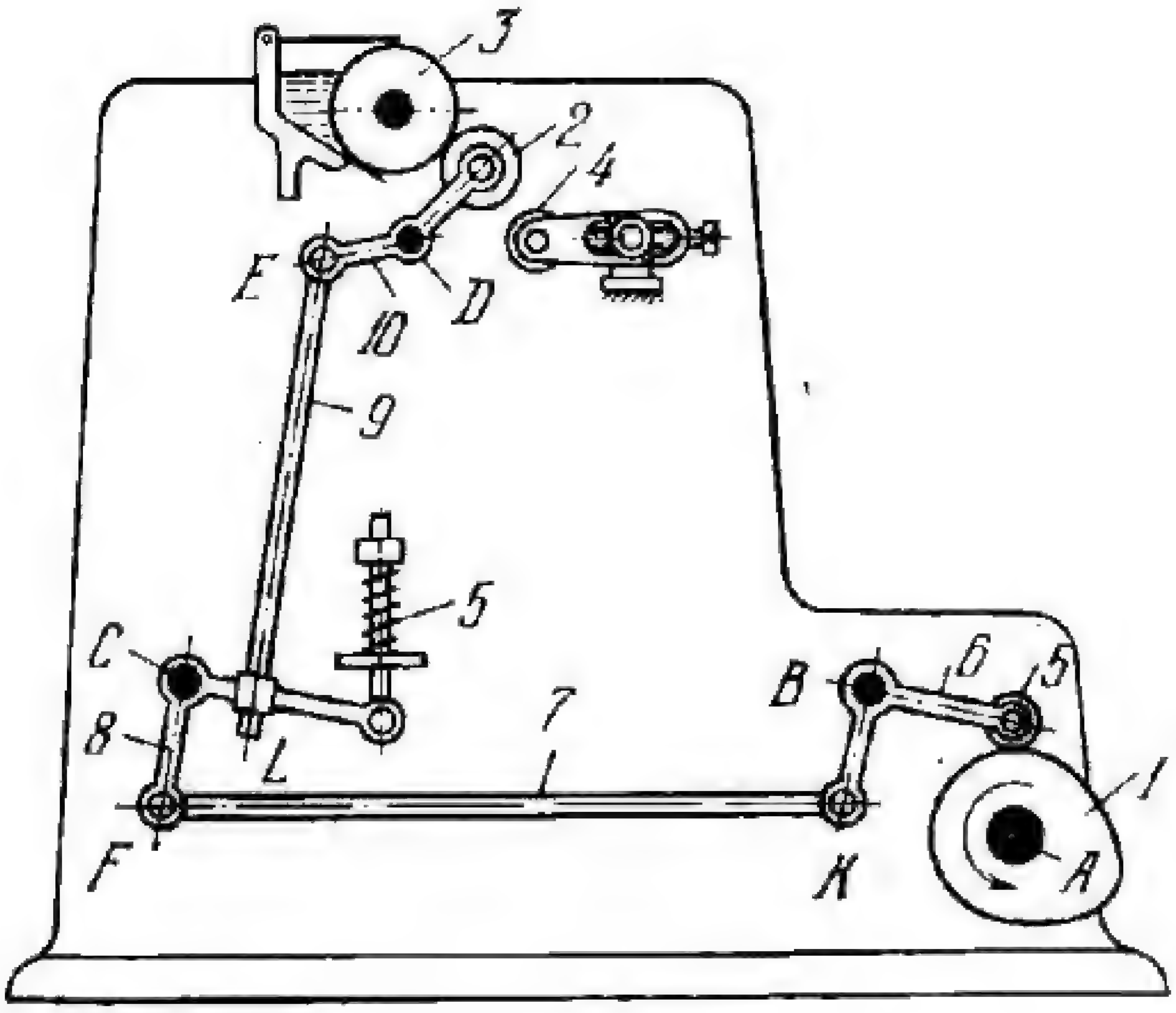
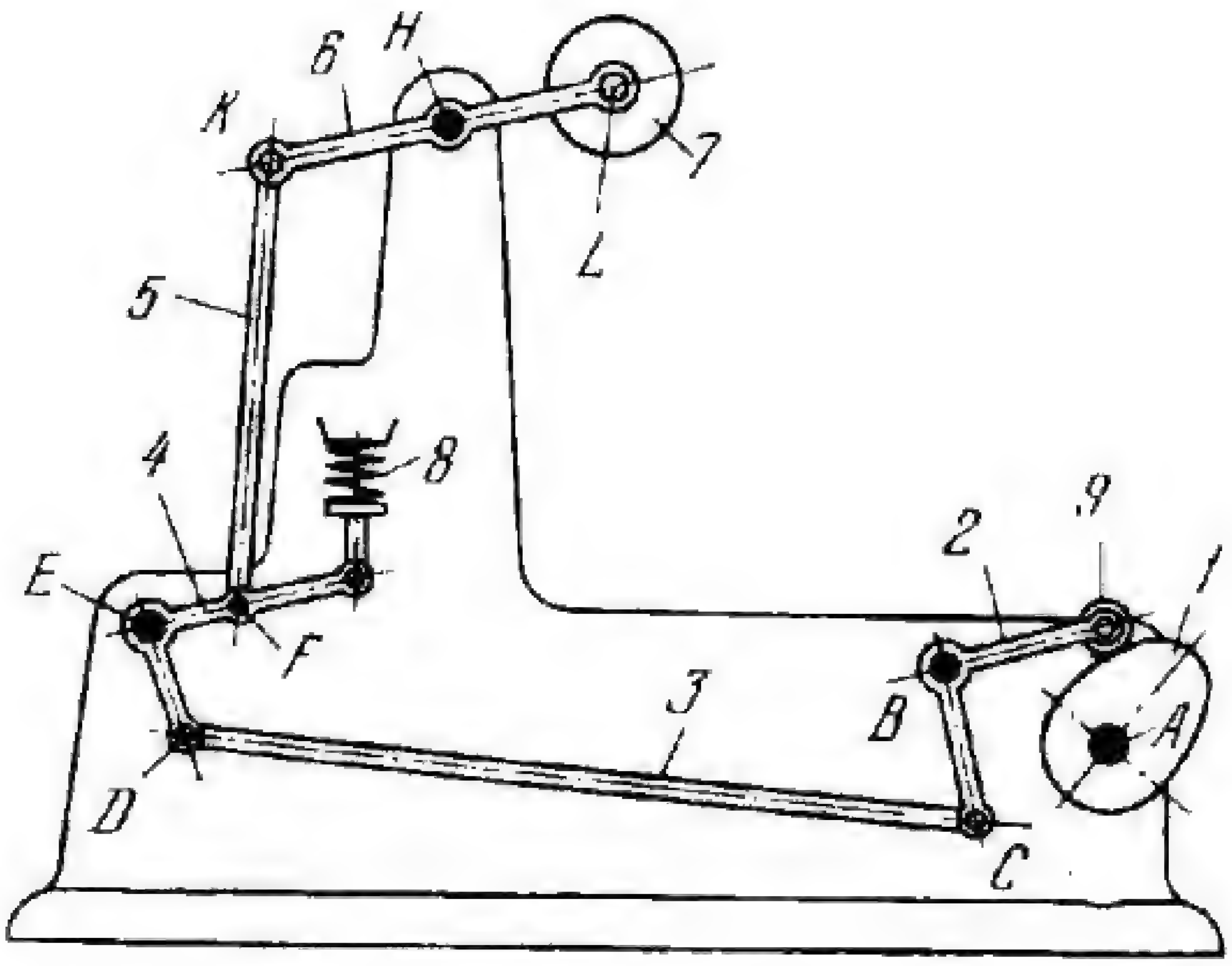


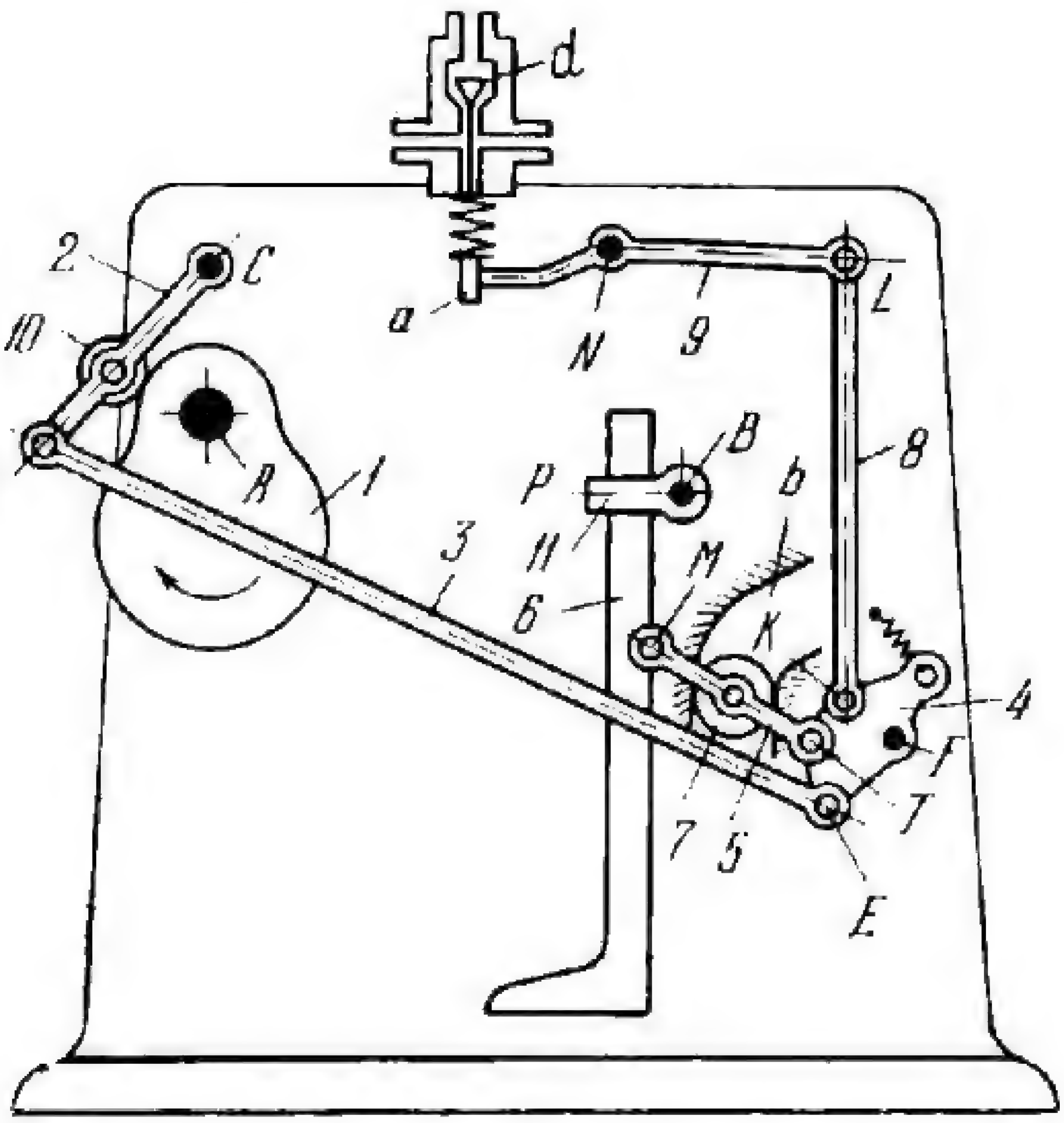
Plate cam *1* rotates about fixed axis *A*. Follower *6* oscillates about fixed axis *B* and carries roller *5* which rolls along the contour of cam *1*. Link *7* is connected by turning pairs *K* and *F* to follower *6* and to link *8* which turns about fixed axis *C*. Link *9* is connected by sliding pair *L* to link *8* and by turning pair *E* to link *10* which turns about fixed axis *D*. Thus cam *1* transmits motion to ink-transfer roller *2* which picks up ink in contact with duct roller *3* and then turns clockwise about axis *D* to transfer the ink to distributor rollers *4*. Spring *5* brings roller *2* into contact with duct roller *3*.

3287	CAM-LEVER MECHANISM OF AN INK-TRANSFER ROLLER	CmL FD



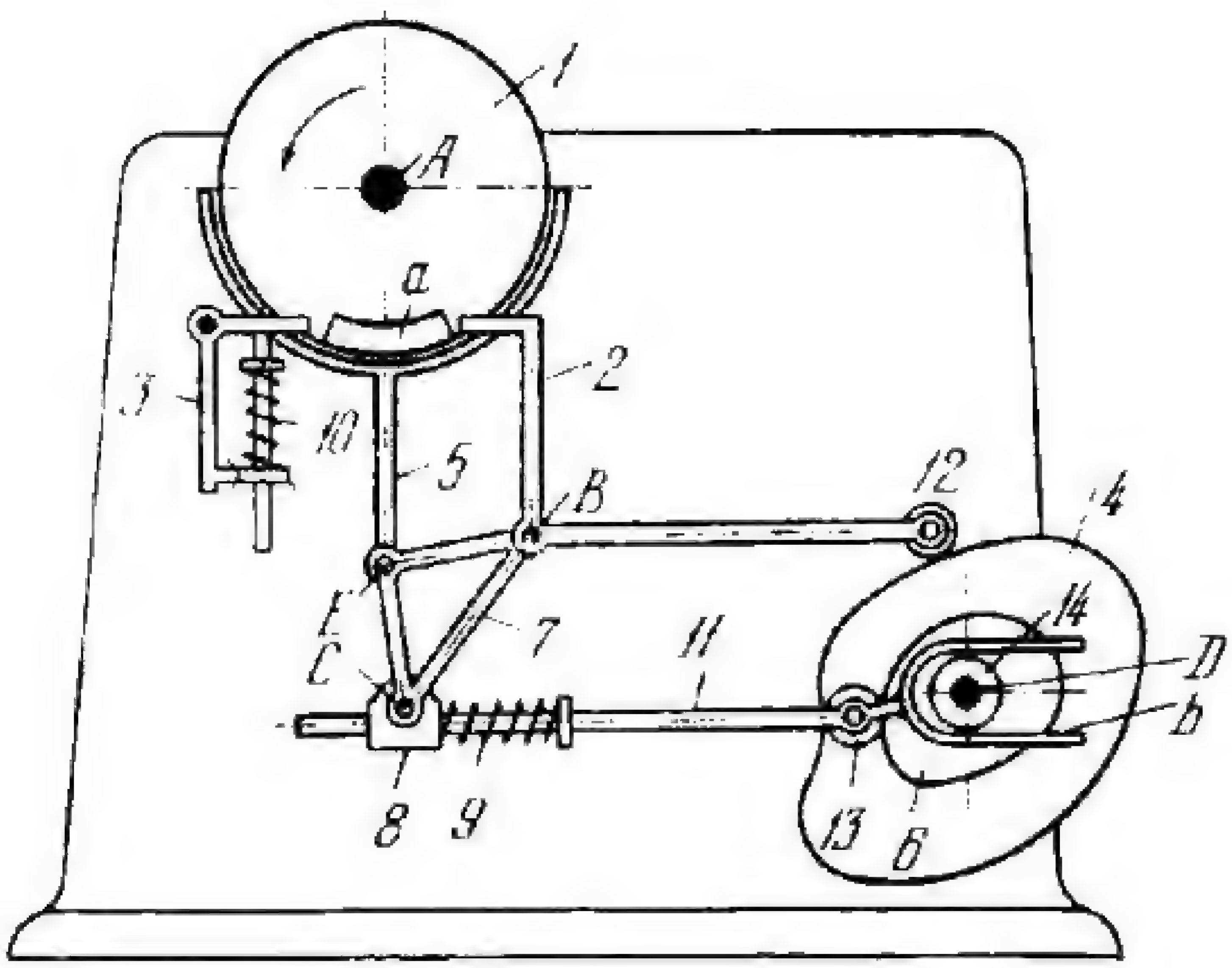
Ink-transfer roller *7*, which transfers ink from the duct roller to the system of distributor rolls, rotates about axis *L* of link *6*. Plate cam *1* rotates about fixed axis *A*. Follower *2* oscillates about fixed axis *B* and carries roller *9* which rolls along the contour of cam *1*. Link *3* is connected by turning pairs *C* and *D* to follower *2* and to link *4* which turns about fixed axis *E*. Link *5* is connected by turning pairs *F* and *K* to link *4* and to link *6* which turns about fixed axis *H*. Roller *9* is held in contact with cam *1* by spring *8*.

3288	CAM-LEVER PAPER FEED MECHANISM	CmL FD



Cam *1* rotates about fixed axis *A*. Follower *2* oscillates about fixed axis *C* and carries roller *10* which rolls along the contour of cam *1*. Link *3* is connected by turning pairs *D* and *E* to follower *2* and to link *4* which turns about fixed axis *F*. Link *8* is connected by turning pairs *K* and *L* to link *4* and to link *9* which turns about fixed axis *N*. Link *5* is connected by turning pairs *M* and *T* to feeler *6* and link *4*, and carries roller *7* which rolls and slides along profiled fixed groove *b*. Feeler *6* is connected by sliding pair *P* to link *11* which turns about fixed axis *B*. Motion is transmitted from cam *1* to feeler *6* which slides vertically and also turns about axis *B*. As the stack of paper is depleted, feeler *6* descends, turning link *9* so that its lug *a* raises valve *d* which connects the vacuum cylinder of the paper feeding mechanism by a pipeline to the vacuum pump.

3289	CAM-LEVER MECHANISM FOR RETURNING AND STOPPING THE IMPRESSION CYLINDER OF A PRINTING PRESS	CmL FD



Rigidly attached plate cams *4* and *6* rotate about fixed axis *D*. Follower *2* oscillates about fixed axis *B* and carries roller *12* which rolls along the contour of cam *4*. Link *11* carries roller *13* which rolls along the contour of cam *6*. Fork *b*, rigidly attached to (or integral with) link *11*, slides along roller *14* which rotates about axis *D*. Link *11* is connected by a sliding pair to slider *8*. Triangular link *7* turns about axis *B* and is connected by turning pairs *C* and *E* to slider *8* and to brake shoe *5*. During the working stroke, the impression cylinder turns about fixed axis *A* through an angle slightly larger than 360°. The impression cylinder is returned to its initial position as follows. Keyed to the shaft of the impression cylinder is disk *1* with cam dog *a*. Follower *2* pushes dog *a* together with the impression cylinder in the reverse direction. Link *3* serves to restrict the motion of dog *a*. The impression cylinder is stopped by brake shoe *5*. Link *3* is held in position and roller *13* is held in contact with cam *6* by springs *10* and *9*.

3290	CAM-LEVER MECHANISM FOR BRAKING THE IMPRESSION CYLINDER OF A PRINTING PRESS	CmL FD

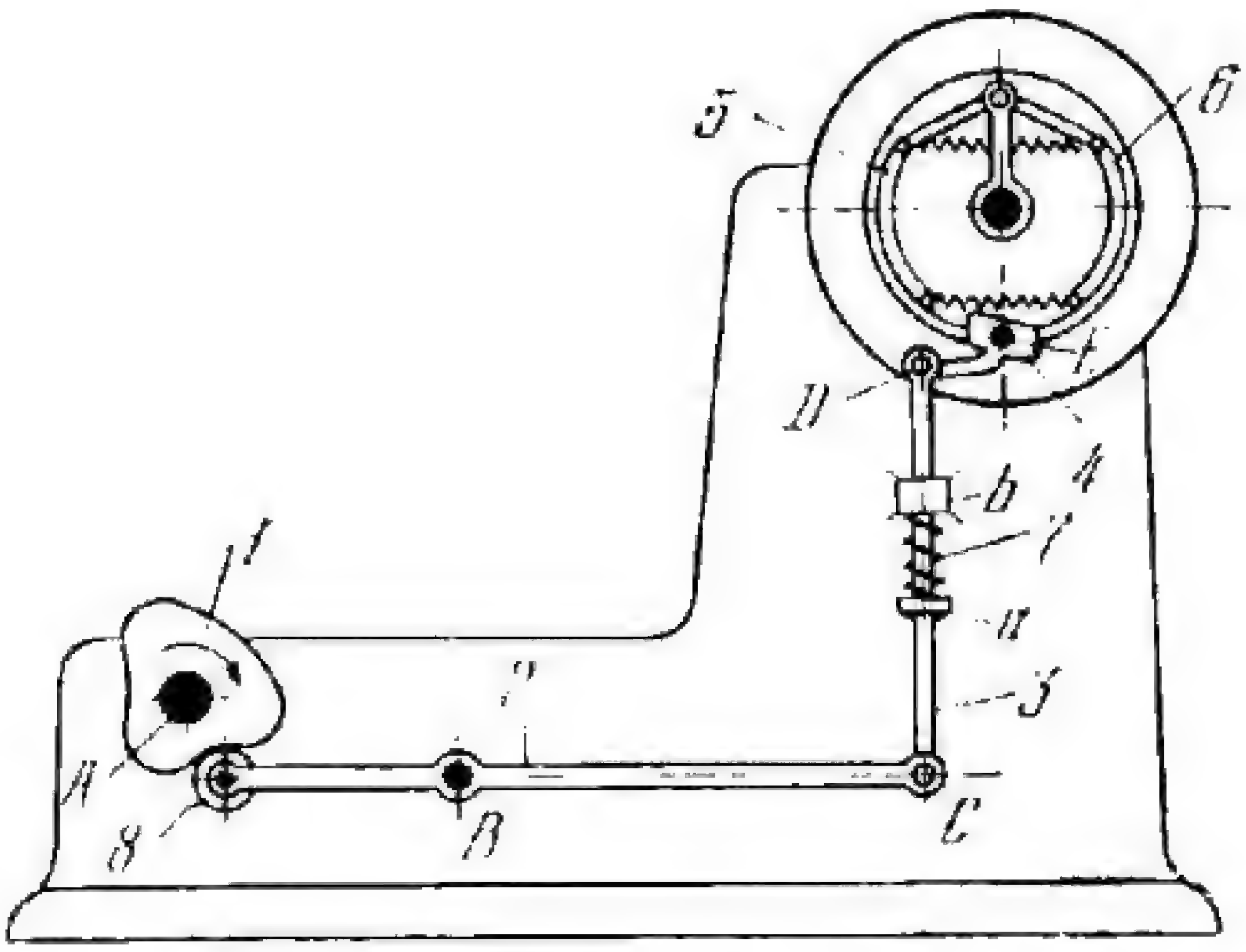


Plate cam *1* rotates about fixed axis *A*. Follower *2* oscillates about fixed axis *B* and carries roller *8* which rolls along the contour of cam *1*. Link *3* is connected by turning pairs *C* and *D* to follower *2* and to cam *4* which turns about fixed axis *E*. Spring *7* bears against collar *a* of link *3* and fixed lug *b*, and holds roller *8* in contact with cam *1*. Cam *1* is keyed to the main shaft of the printing press and transmits motion to cam *4*. When cam *4* turns, brake shoes *5* and *6* are spread to brake and stop the impression cylinder.

3291	CAM-LEVER BRAKE SHOE MECHANISM FOR CLAMPING PAPER	CmL FD

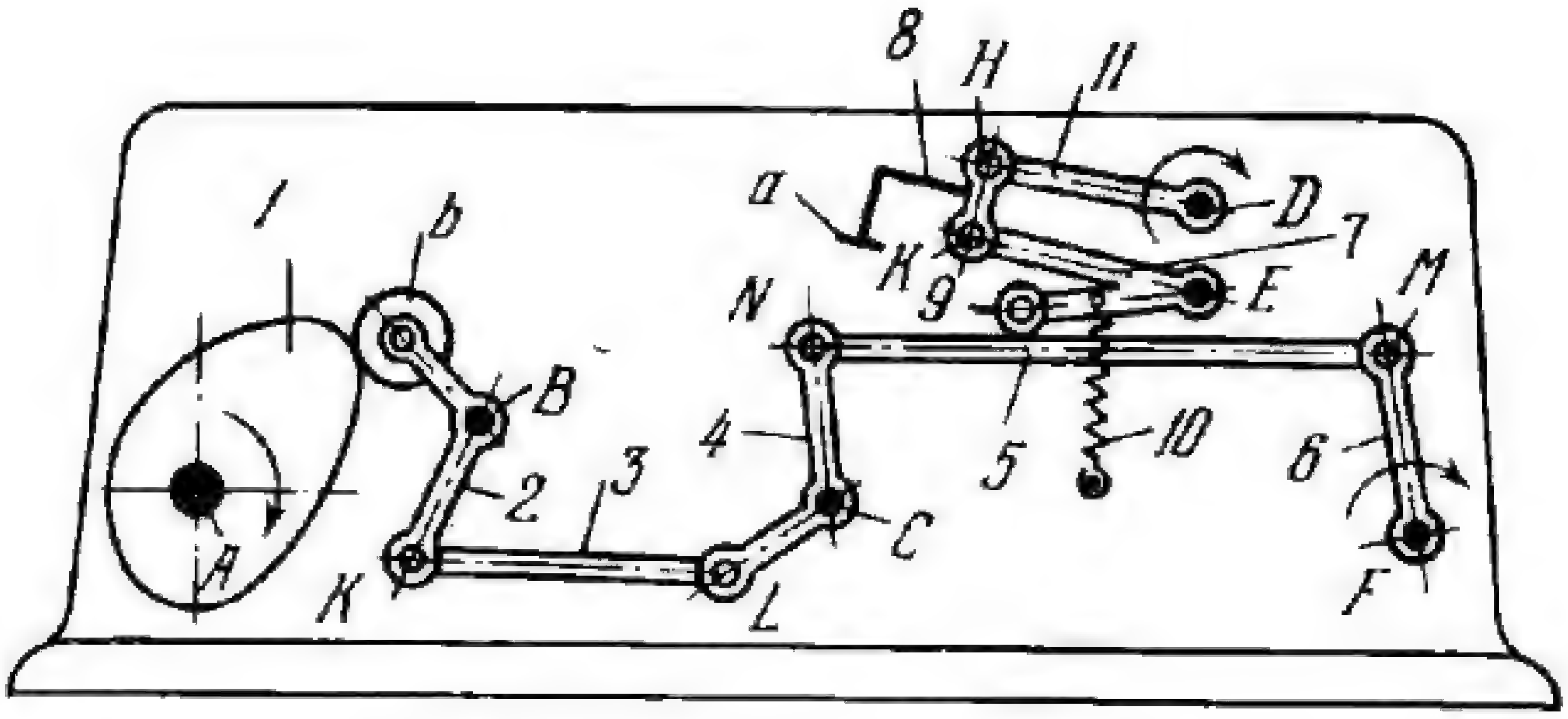
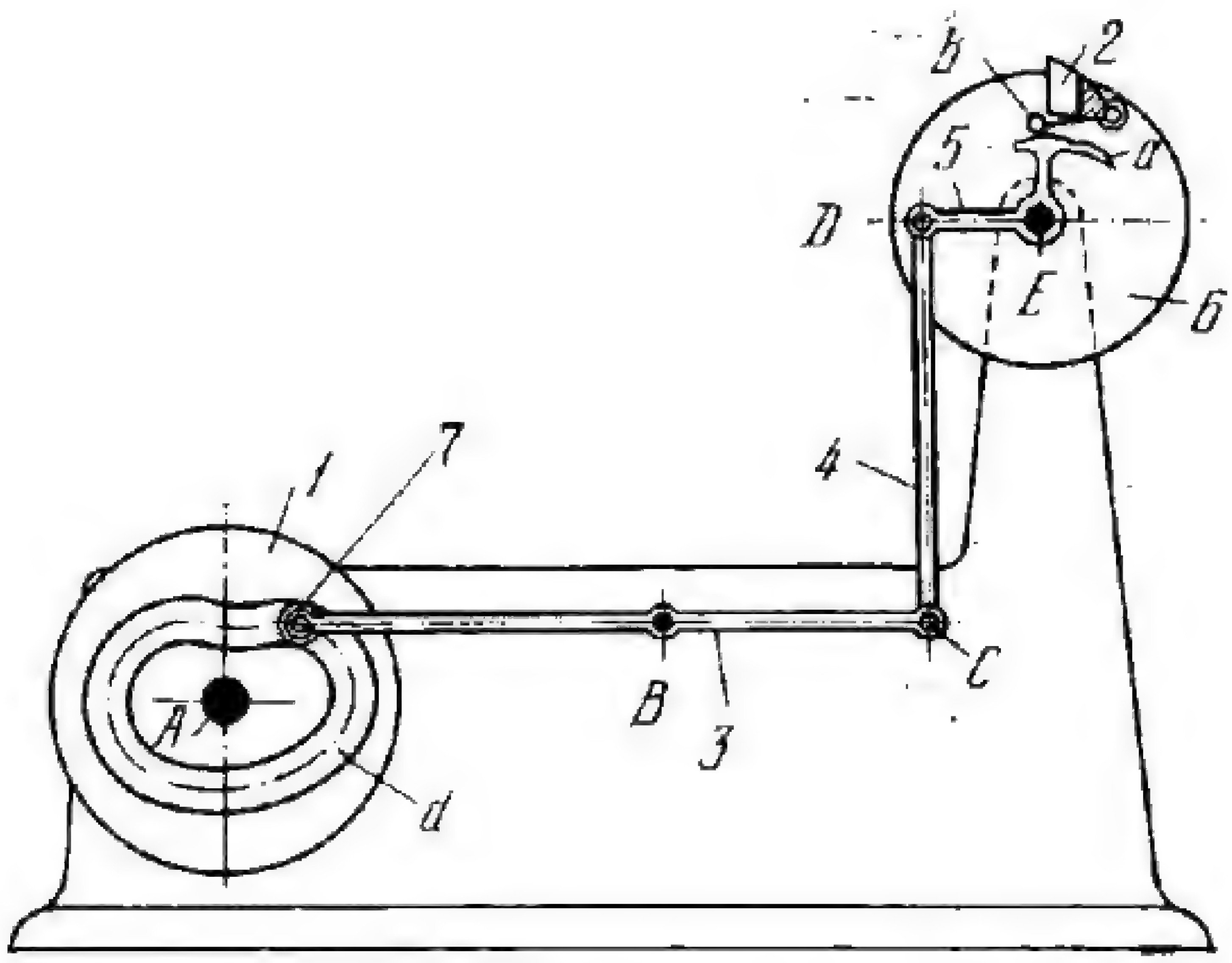


Plate cam *1* rotates about fixed axis *A*. Follower *2* oscillates about fixed axis *B* and carries roller *b* which rolls along the contour of cam *1*. Link *3* is connected by turning pairs *K* and *L* to follower *2* and to link *4* which turns about fixed axis *C*. Link *5* is connected by turning pairs *N* and *M* to link *4* and to link *6* which turns about fixed axis *F*. Link *7* turns about fixed axis *E* and carries roller *9* which rolls along link *5*. Link *8* with shoe *a* is connected by turning pairs *K* and *H* to link *7* and to link *11* which turns about fixed axis *D*. When cam *1* turns, shoe *a* of link *8* descends to the stack of paper and clamps it. Rollers *9* and *b* are held in contact with link *5* and cam *1* by spring *10*.

3292	CAM-LEVER MECHANISM FOR GRIPPING PAPER SHEETS	CmL FD



Face cam *1* and impression cylinder *6* are rotated about fixed axes *A* and *E* by a drive powered from the main shaft of the printing press. Cam *1* has profiled groove *d*. Follower *3* oscillates about fixed axis *B* and carries roller *7* which rolls and slides along groove *d*. Link *4* is connected by turning pairs *C* and *D* to follower *3* and to link *5* which turns about axis *E* and has shaped end *a*. At the moment in the rotation of the impression cylinder when the sheet is ejected, roller *b* of grip *2* runs onto shaped end *a* of link *5*, grip *2* opens and releases the sheet. At this point, link *5* starts to turn. During the time the impression cylinder stands idle, the grips are open. The grips are closed by a spring (not shown) at the moment the cylinder starts its working movement.

3293	CAM-LEVER MECHANISM OF THE GRIPS OF AN IMPRESSION CYLINDER	CmL FD

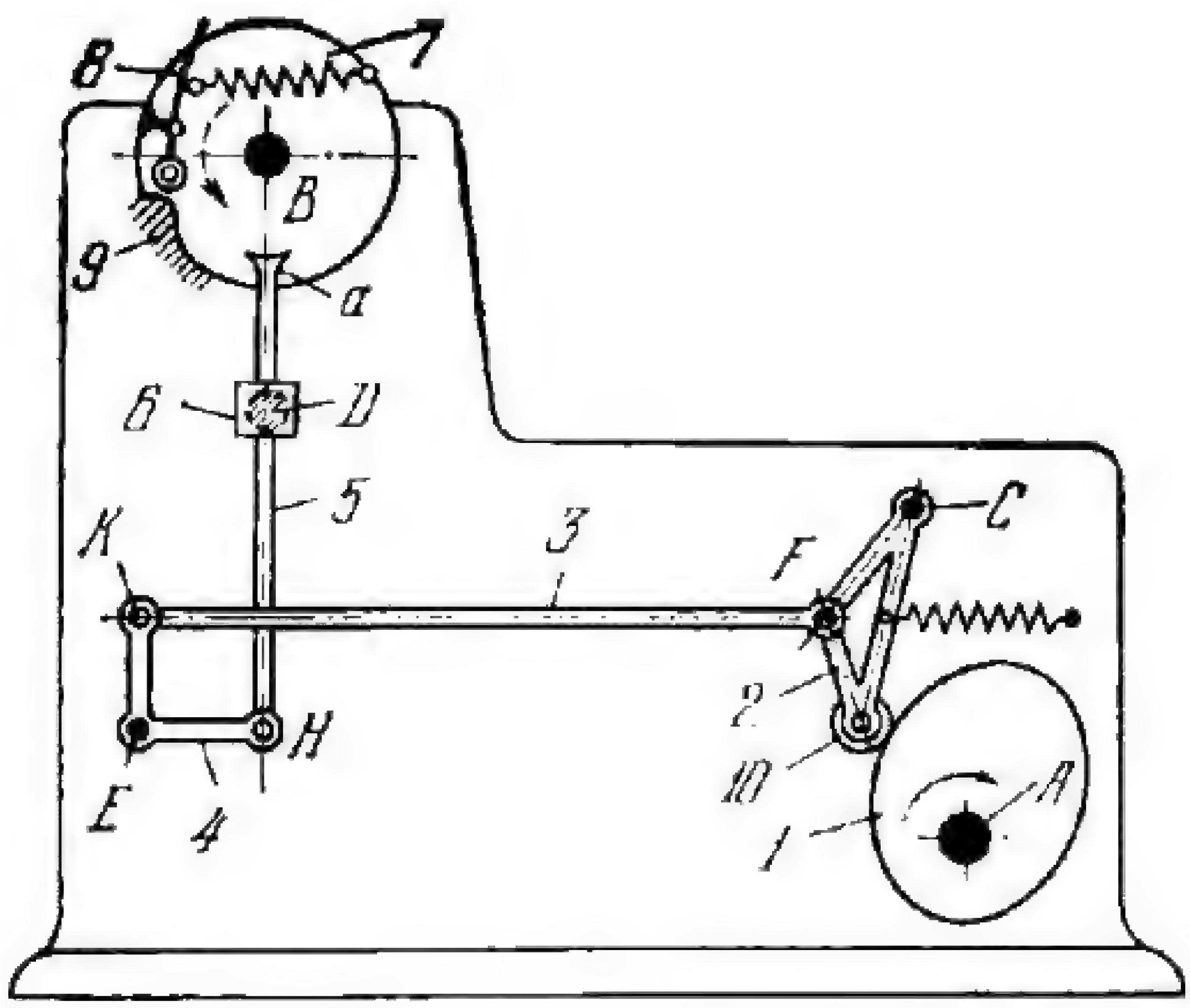


Plate cam *1* and impression cylinder *7* are rotated about fixed axes *A* and *B* by a drive powered from the main shaft of the printing press. Follower *2* oscillates about fixed axis *C* and carries roller *10* which rolls along the contour of cam *1*. Link *3* is connected by turning pairs *F* and *K* to follower *2* and to link *4* which turns about fixed axis *E*. Link *5* is connected by turning pair *H* to link *4* and slides in link *6* which turns about fixed axis *D*. Link *5* has shaped end *a*. When, in the rotation of impression cylinder *7*, grip *8* runs onto fixed cam *9*, the grip opens to transfer the sheet of paper to the sheet extracting device. When the grip runs onto shaped end *a*, the grips open again so as to grip the next sheet.

3294	CAM-LEVER MECHANISM OF A LINOTYPE PUMP	CmL FD

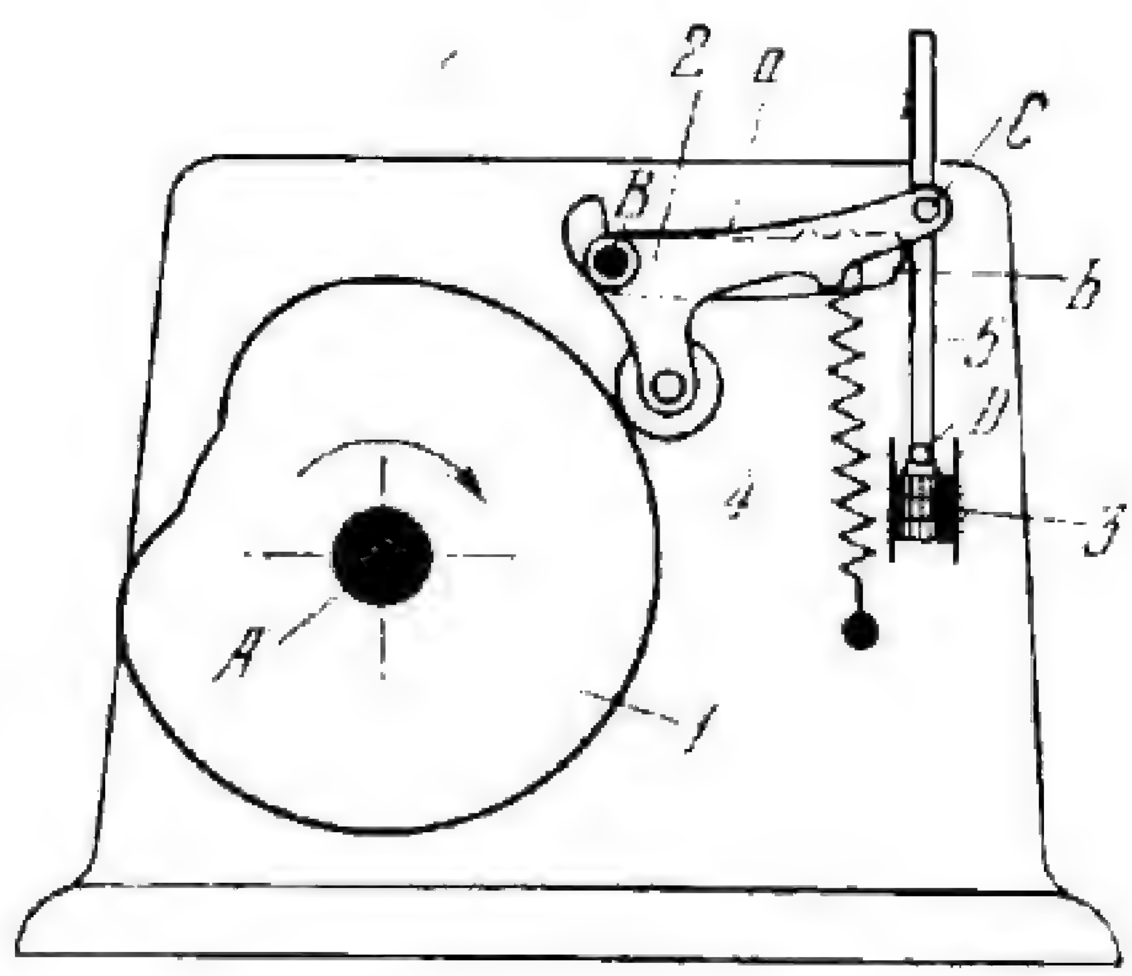


Plate cam *1* rotates about fixed axis *A* and transmits motion to follower *2*, which oscillates about fixed axis *B*. Intermediate link *5* is connected by turning pairs *C* and *D* to follower *2* and to piston *3*. Follower *2* consists of two rigidly attached members, *a* and *b*. The piston is pivoted to member *a*. Attached to member *b* is spring *4* which can be adjusted along link *2* to vary its tension. Spring *4* holds the roller of follower *2* in contact with cam *1*.

3295	CAM-LEVER MECHANISM OF A PACKING MACHINE	CmL FD

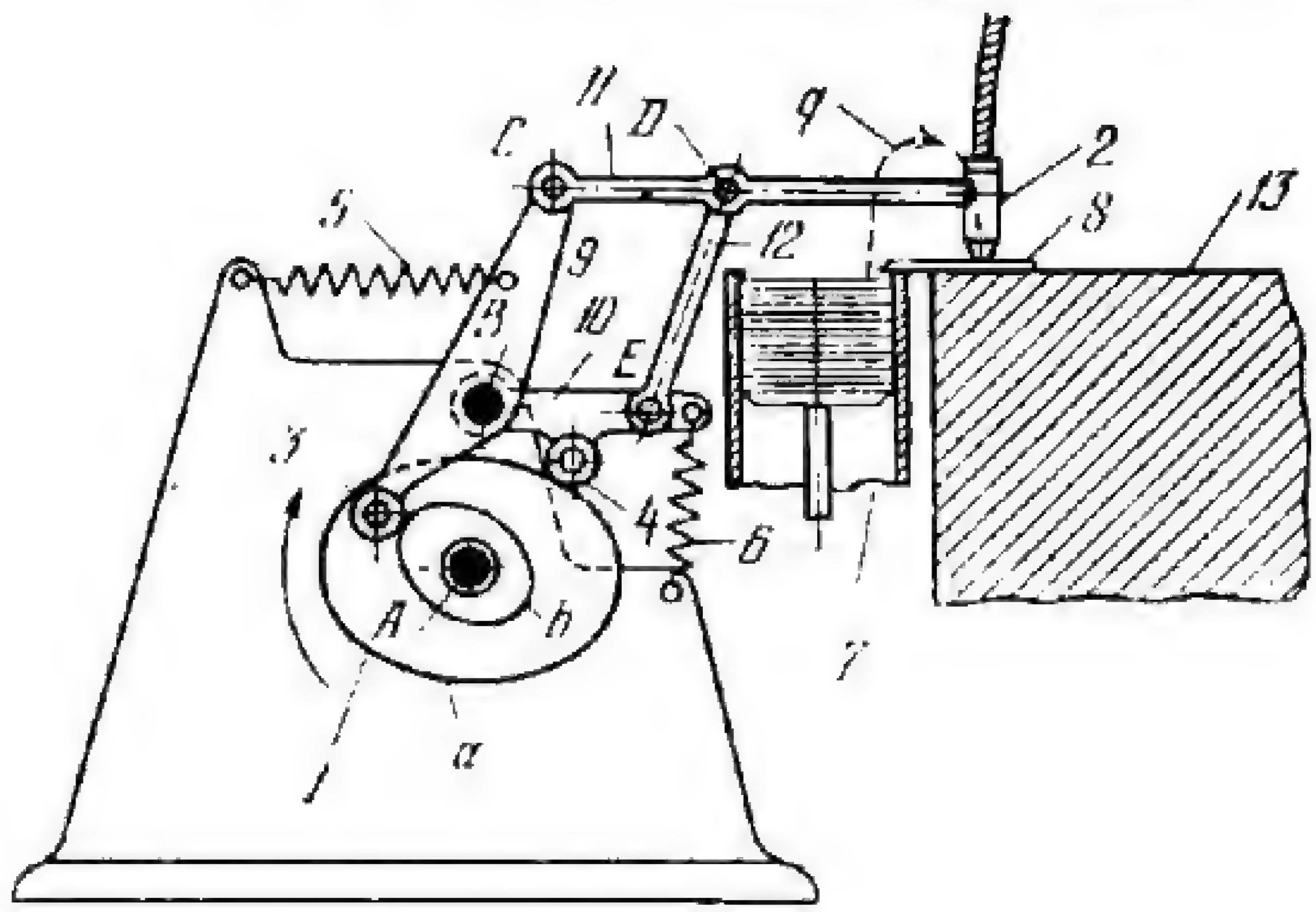
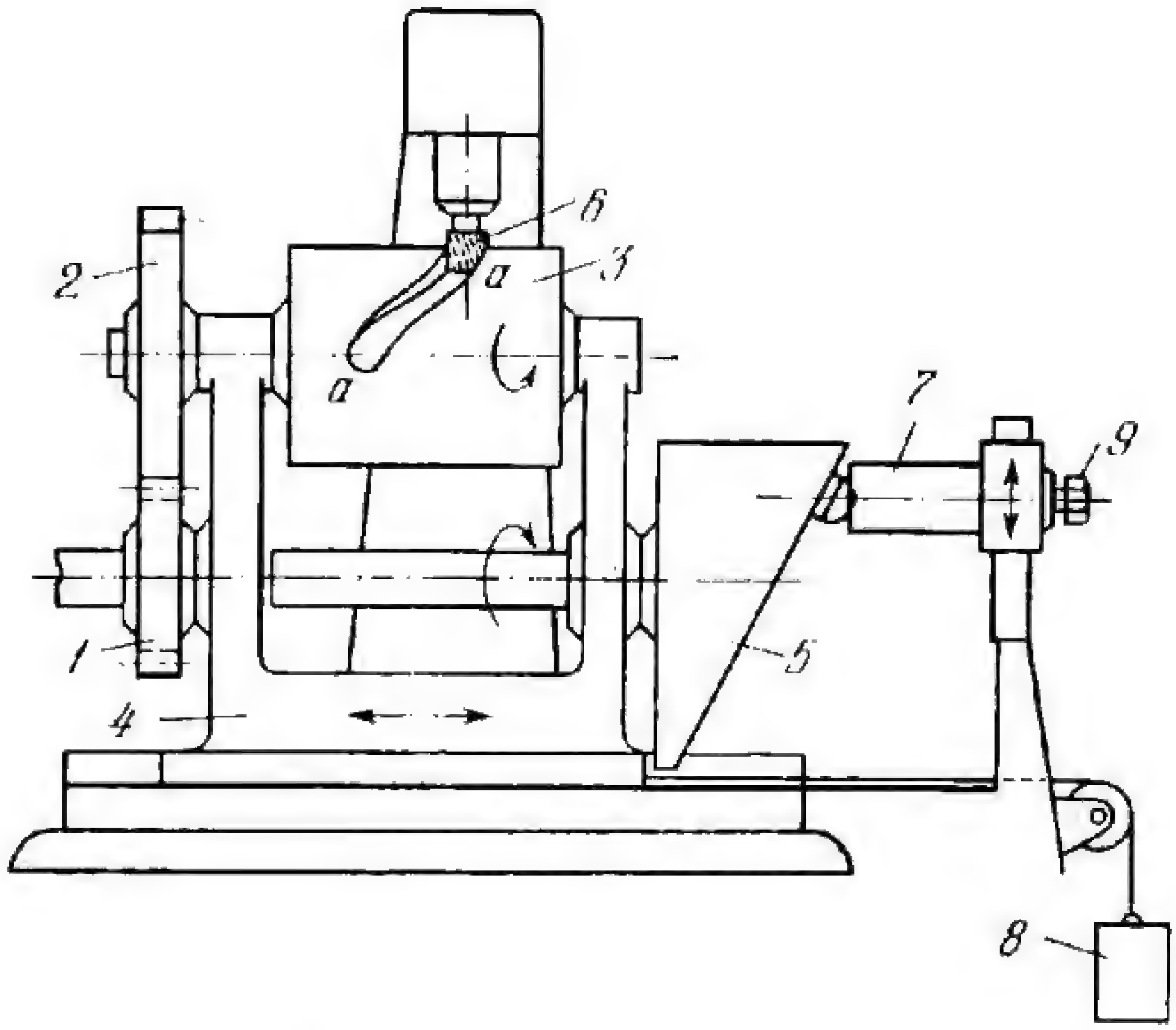


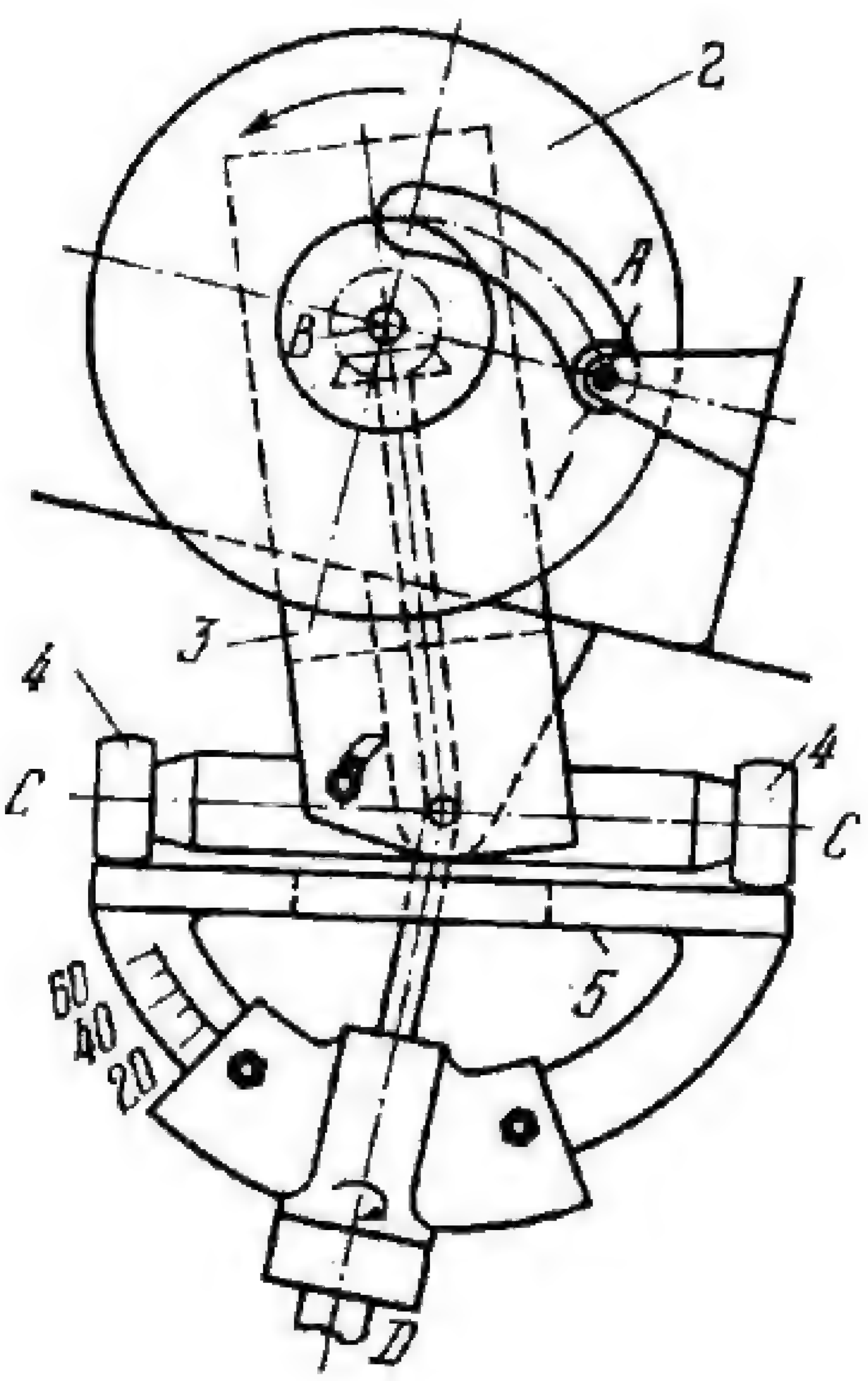
Plate cam *1* rotates about fixed axis *A* and has two profiled contours *a* and *b*. Followers *9* and *10* turn independently about fixed axis *B* and carry rollers *3* and *4* which roll along contours *b* and *a*. Link *11* is connected by turning pairs *C* and *D* to follower *9* and to link *12* which, in turn, is connected by turning pair *E* to follower *10*. Mounted at the end of link *11* is suction tip *2* which picks up sheets *8* out of hopper *7* and carries them over to table *13*, describing path *q*.

3296	CAM-LEVER SPATIAL MECHANISM OF A TRACING ATTACHMENT FOR MILLING CYLINDER CAMS	CmL FD



The spindle of milling cutter *6* runs in fixed bearings. Cam blank *3* and end cam *5* are rotated by a drive through meshing gears *1* and *2*. Axial motion of cam blank *3* with slide *4* is obtained by profiled inverse end cam *5* which contacts fixed bar *7*. Weight *8* holds cam *5* in contact with bar *7*. Cam grooves *a-a* of various shapes can be milled by properly designing the working surface of cam *5* and by clamping bar *7* in various positions with bolt *9*.

3297	CAM-LEVER SPATIAL MECHANISM OF A TRACING ATTACHMENT FOR MILLING SINE-CURVE FACE CAMS	CmL FD



Milling cutter *1* rotates about fixed axis *A*. Disk-shape cam blank *2* turns about suspended axis *B*. Axis *B* is traversed together with member *3* which is rigidly attached to axis *C* of rollers *4*. Rollers *4* roll along spatial end cam *5*. Cam *5* rotates about fixed axis *D* and its working surface is a plane which can be set to various angles with respect to axis *D*. The profile of the cam groove is obtained by the combined rotary motion of cam blank *2* and the motion imparted to member *3* by cam *5*.

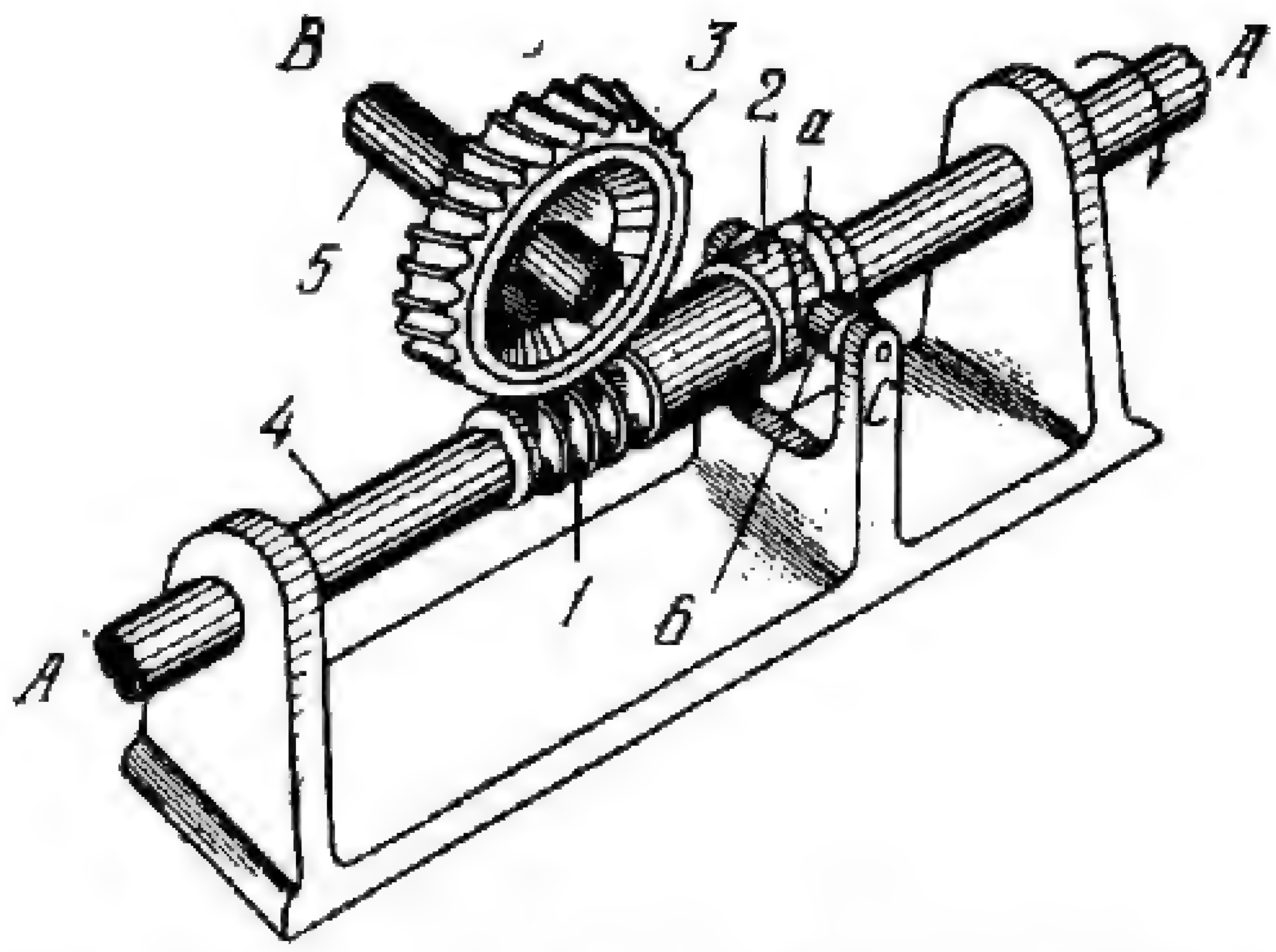
SECTION TWENTY-TWO

Gear-Cam Mechanisms

GrC

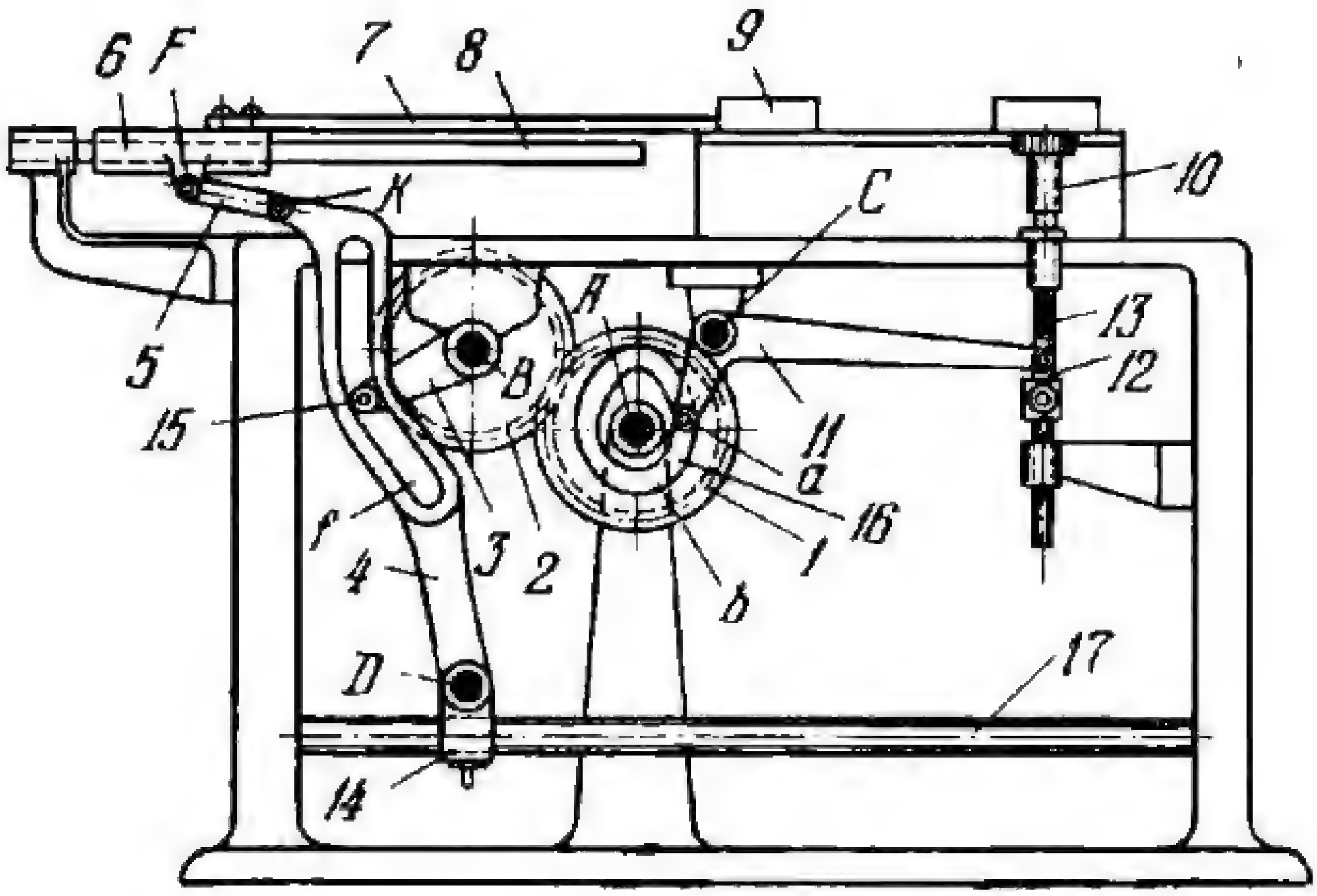
1. General-Purpose Multiple-Link Mechanisms ML (3298 through 3316)
2. Dwell Mechanisms D (3317 through 3323)
3. Mechanisms for Generating Curves Ge (3324)
4. Mechanisms for Mathematical Operations MO (3325 through 3328)
5. Operating Claw Mechanisms of Motion Picture Cameras OC (3329 through 3332)
6. Piston Machine Mechanisms PM (3333)
7. Indexing Mechanisms I (3334)
8. Link-Length Adjustment Mechanisms LL (3335)
9. Mechanisms of Other Functional Devices FD (3336 through 3340)

3298	WORM GEARING-CAM MECHANISM FOR NONUNIFORM ROTATION	GrC ML



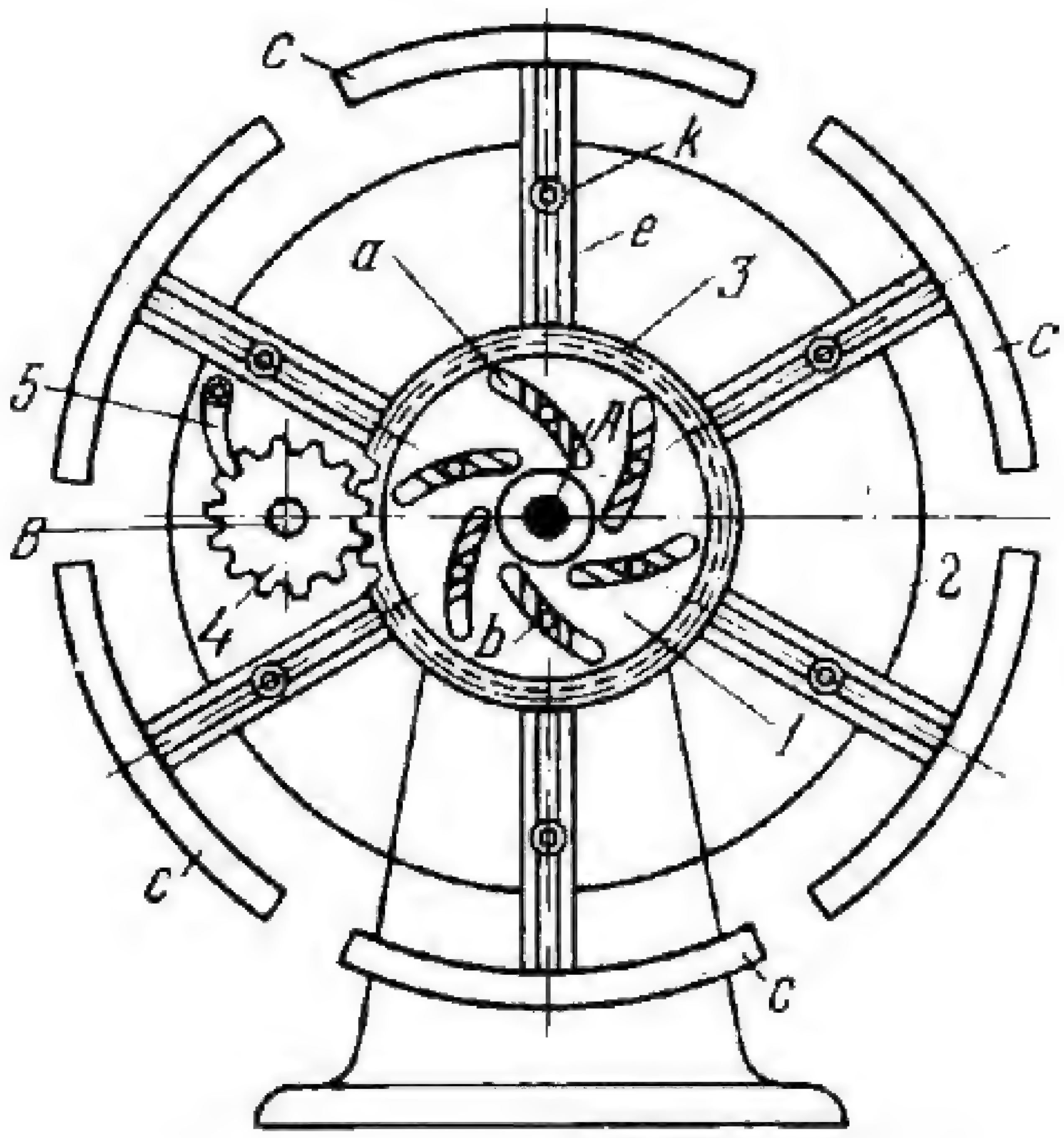
Worm *1* and cylinder cam *2* are rigidly attached together and can slide axially along a feather key on shaft *4* which rotates about fixed axis *A-A*. Worm *1* meshes with worm wheel *3* which is keyed to shaft *5* and rotates about fixed axis *B*. Roller *6* rotates about fixed *C* and rolls and slides along profiled groove *a* of cam *2*. When shaft *4* rotates at uniform speed, worm *1* and cam *2* rotate and reciprocate axially, transmitting nonuniform rotation to worm wheel *3* and shaft *5*, which depends on the profile of groove *a*.

3299	GEAR-CAM MECHANISM PROVIDING FEED IN TWO PERPENDICULAR DIRECTIONS	GrC ML



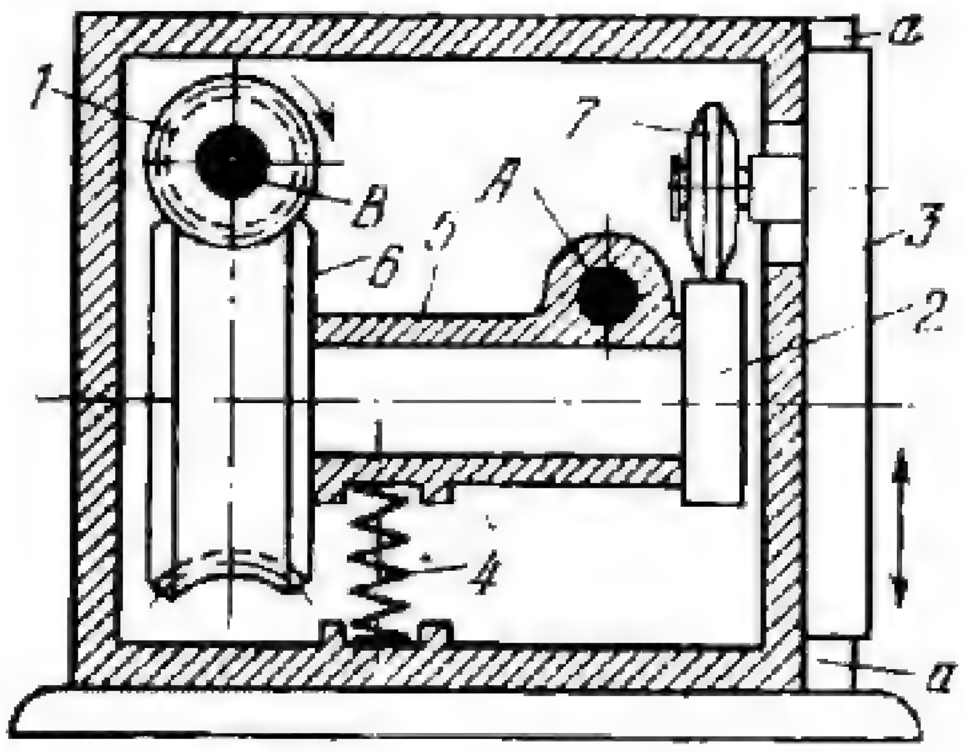
Meshing gears *1* and *2* rotate about fixed axes *A* and *B*. Crank *3*, rigidly attached to gear *2*, carries roller *15* which rolls and slides along profiled slot *f* of rocker arm *4*. Rocker arm *4* oscillates about fixed axis *D* and is connected by turning pair *K* to link *5* which, in turn, is connected by turning pair *F* to slide *6*. Slide *6* reciprocates along fixed guide *8* and carries pusher *7* which advances workpiece *9* horizontally to the right onto support *10*. Follower *11* oscillates about fixed axis *C* and carries roller *a* which rolls and slides along profiled groove *b* of face cam *16*, rigidly attached to gear *1*. Follower *11* is connected by link *12* to plunger *13* which raises support *10*. When gear *1* rotates, workpiece *9* is first advanced to support *10* and then raised vertically by the support. The end point of the stroke of pusher *7* can be varied by adjusting bracket *14* along bar *17* and clamping it in the required position.

3300	GEAR-CAM MECHANISM OF A VARIABLE-DIAMETER PULLEY	GrC ML



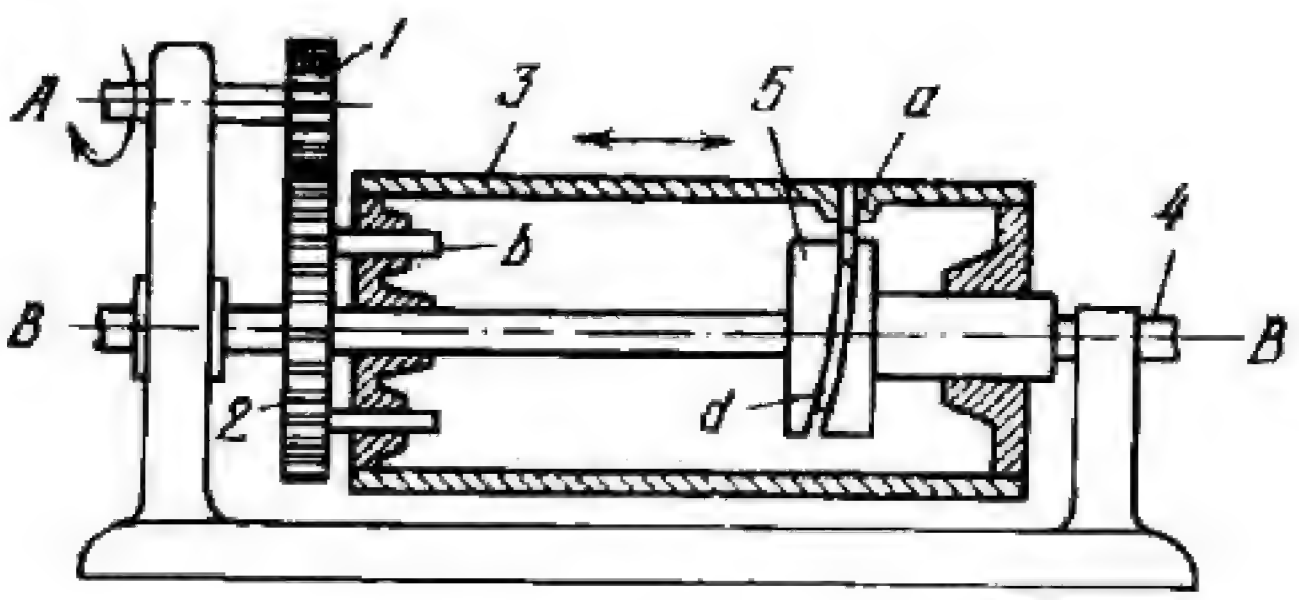
Face cam *1* has symmetrically located identical curvilinear grooves *a* and rotates together with the pulley assembly about fixed axis *A*. Cam *1* is rigidly attached to (or integral with) gear *3* and can be turned about axis *A* with respect to disk *2* by gear *4* which is connected by turning pair *B* to disk *2* and meshes with gear *3*. After being turned to the required position, gear *4* is locked by means of pawl *5*. The rim of the variable-diameter pulley consists of sectors *c* whose slotted members *e* carry pins *b* which slide along grooves *a*. Slotted members *e* slide along pins *k* of disk *2*. When cam *1* is turned with respect to disk *2*, the grooves of the cam actuate pins *b*, simultaneously expanding or contracting the pulley by moving sectors *c* either away from or toward centre *A*.

3301	WORM GEARING-CAM PRECISE SETTING MECHANISM	GrC ML



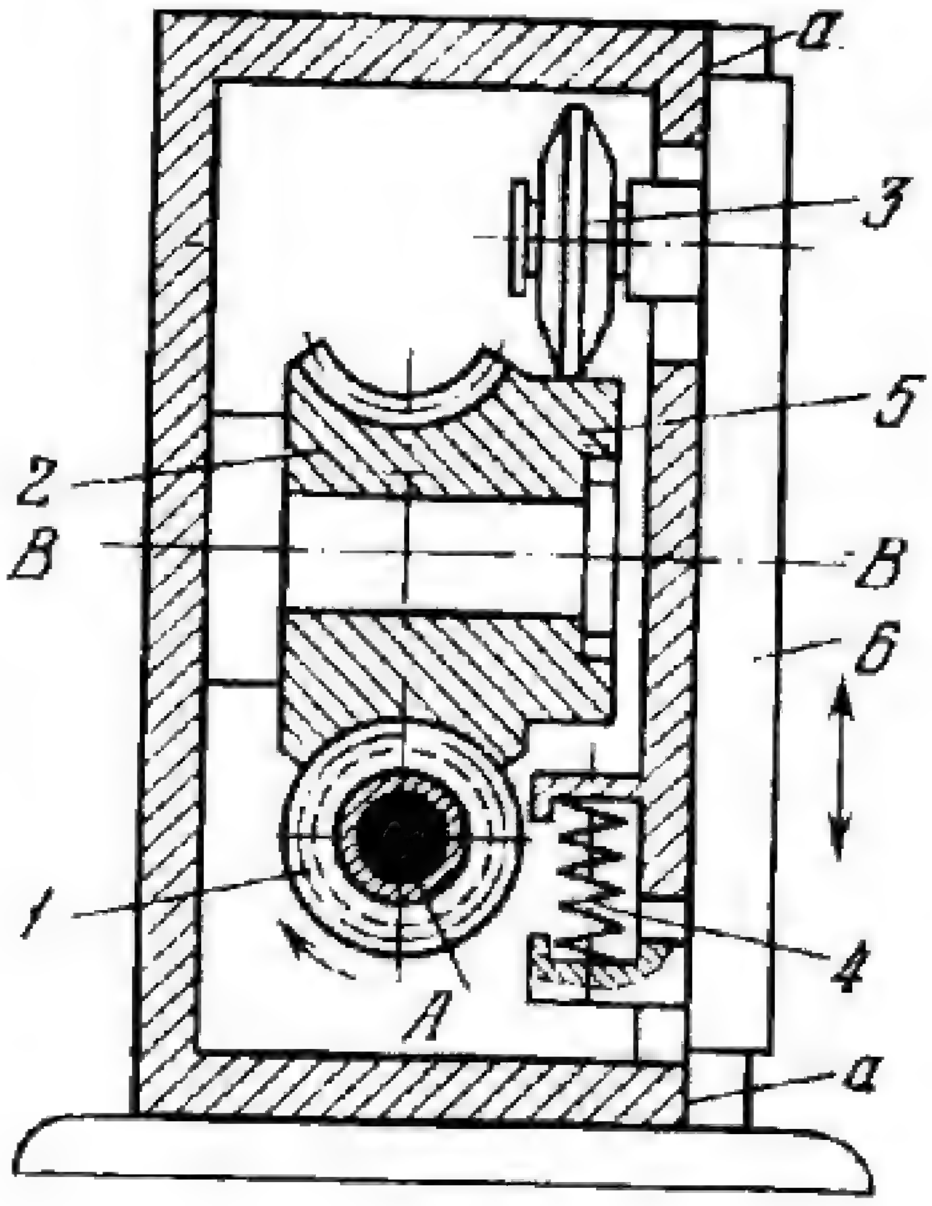
Worm *1* rotates about fixed axis *B* and meshes with worm wheel *6* whose bearing *5* can turn about fixed axis *A*. Plate cam *2* is rigidly attached to worm wheel *6* and has a working surface along an Archimedean spiral. Slide *3* can be moved along fixed guides *a-a*. Slide *3* mounts roller *7* which contacts cam *2*. Slide *3* can be precisely set by turning worm *1*. Spring *4* eliminates backlash in the worm gearing. The weight of slide *3* holds roller *7* in contact with cam *2*.

3302	GEAR-CAM AXIAL RECIPROCATION MECHANISM FOR A DISTRIBUTOR ROLLER	GrC ML



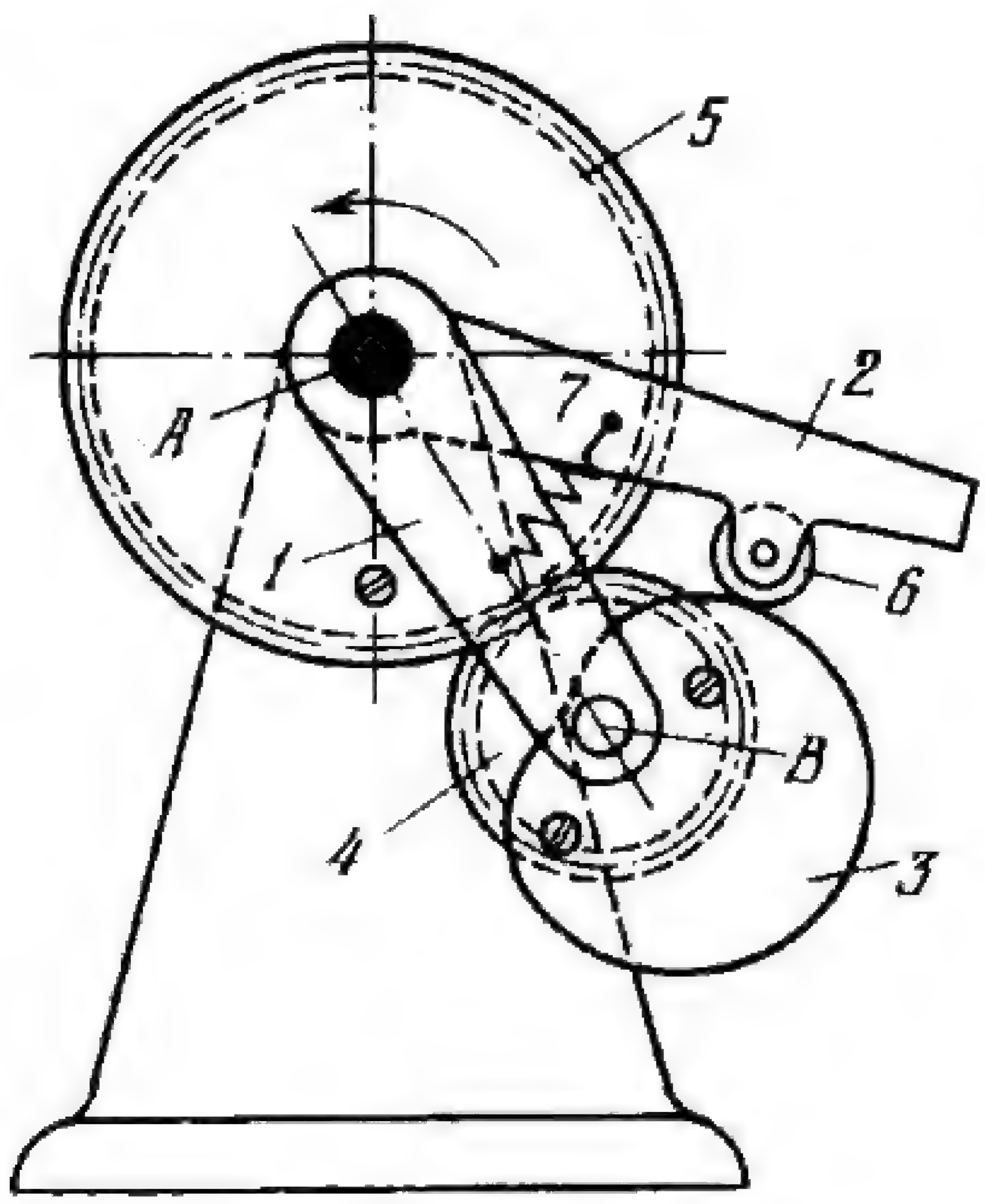
Gear *1* rotates about fixed axis *A* and meshes with gear *2* which rotates freely on shaft *4* about fixed axis *B-B*. Gear *2* has pins *b* which enter holes in the end face of distributor roller *3* which can rotate about and slide on fixed shaft *4* along axis *B-B*. Cylinder cam *5* with profiled groove *d* is keyed to shaft *4*. Inside roller *3* is pin *a* which slides along groove *d*. When gear *1* rotates, distributor roller *3* rotates about and reciprocates along axis *B-B*.

3303	WORM GEARING-CAM SPATIAL RECIPROCATING MECHANISM	GrC ML



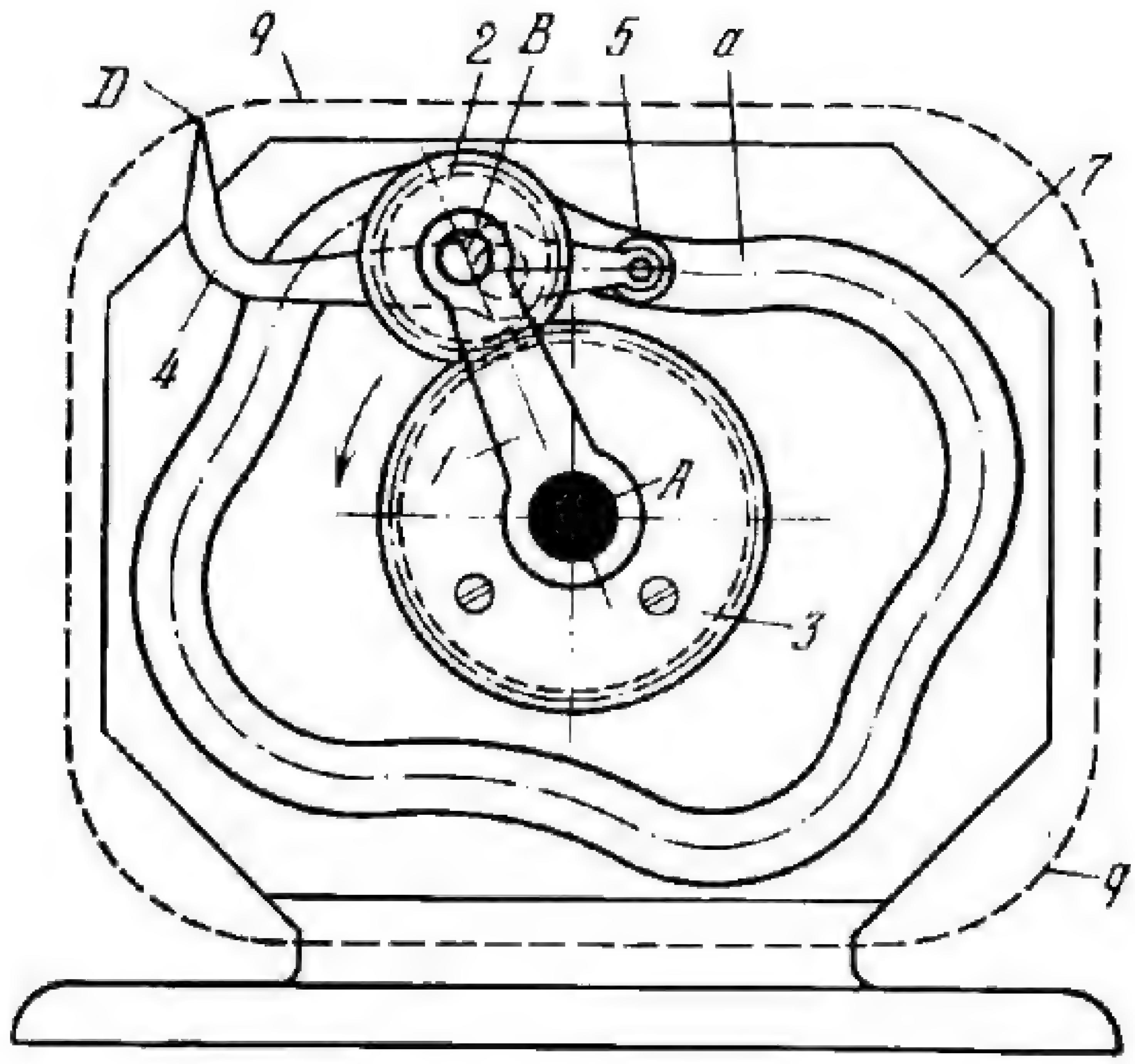
Worm *1* rotates about fixed axis *A* and meshes with worm wheel *2* which rotates about fixed axis *B-B*. Cam *5* is integral with worm wheel *2*, its working surface being machined on the wheel hub. Follower *6* reciprocates along fixed guides *a-a* and carries roller *3* which rolls along the contour of cam *5*. Roller *3* is held in contact with cam *5* by spring *4*.

3304	GEAR-CAM PLANETARY MECHANISM	GrC ML



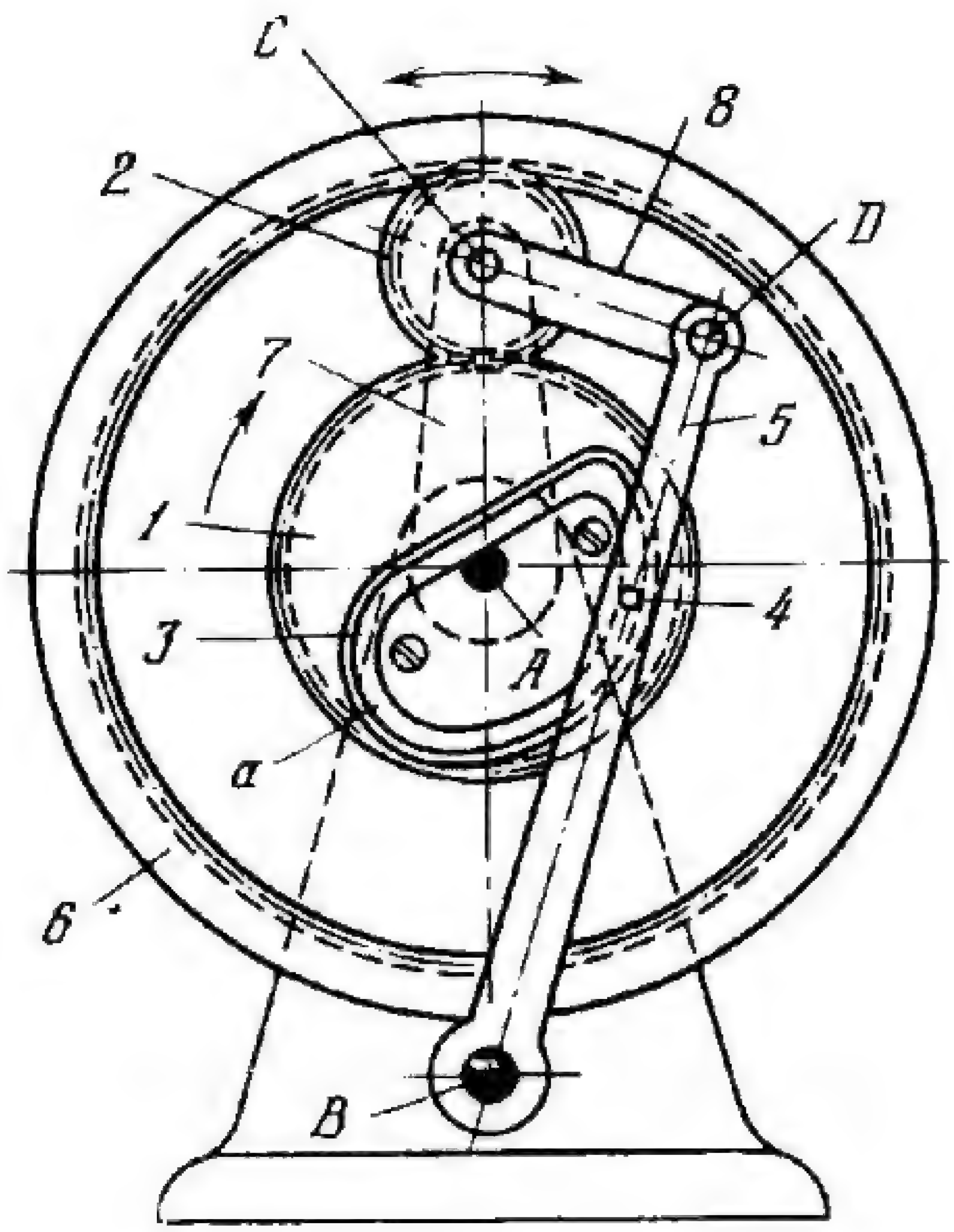
Carrier *1* rotates about fixed axis *A* and is connected by turning pair *B* to planet gear *4* which meshes with fixed sun gear *5* and is rigidly attached to plate cam *3*. Rocker arm *2* rotates about axis *A* and carries roller *6* which rolls along the contour of cam *3*. When carrier *1* rotates at uniform speed, rocker arm *2* rotates at nonuniform speed. Roller *6* is held in contact with cam *3* by spring *7*.

3305	FIXED-CAM PLANETARY GEARING MECHANISM	GrC ML



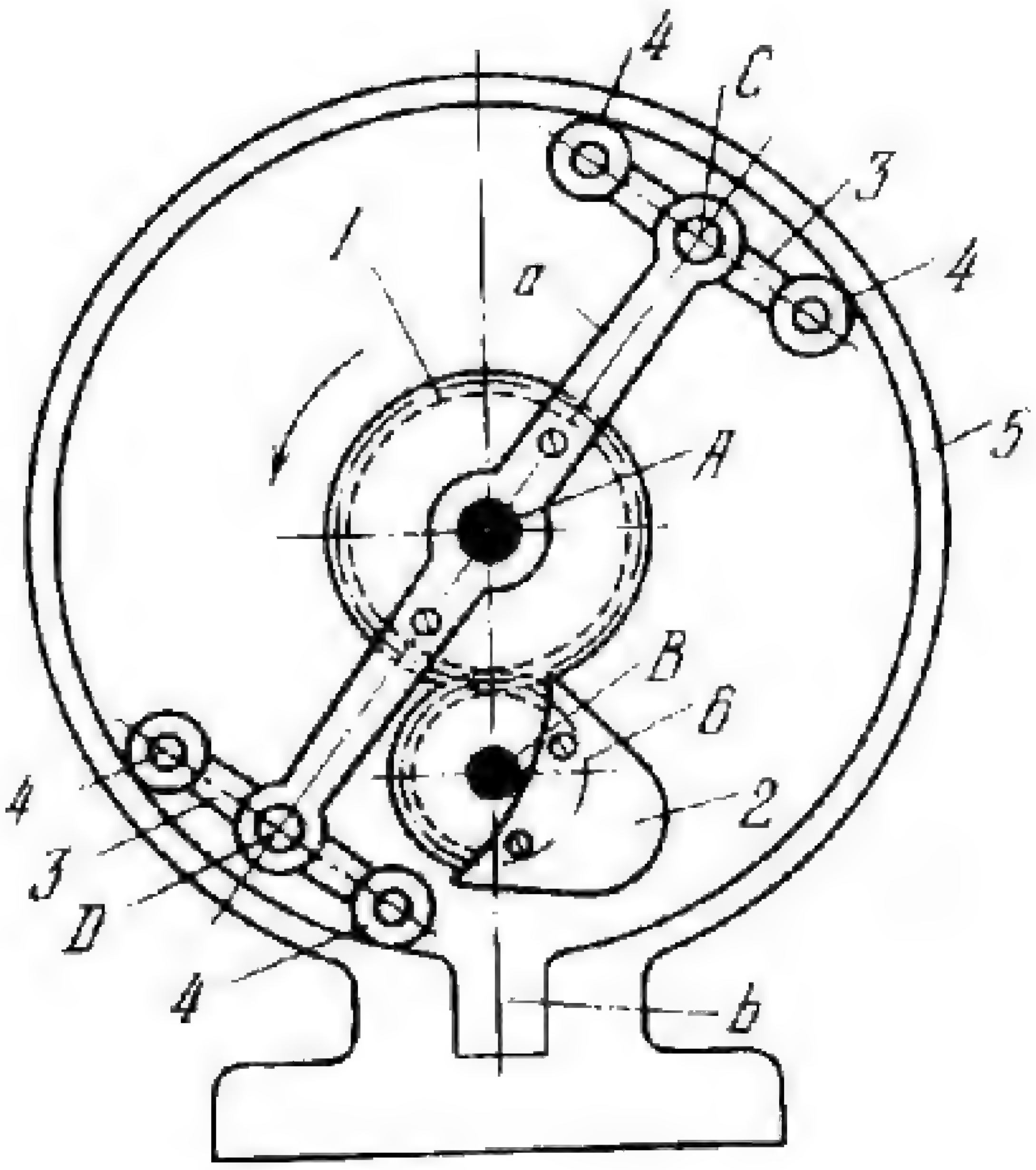
Carrier *1* rotates about fixed axis *A* and is connected by turning pair *B* to planet gear *2* which meshes with fixed sun gear *3*. Link *4* is connected by a turning pair to carrier *1* and carries roller *5* which rolls and slides along profiled groove *a* of fixed face cam *7*. Groove *a* is designed so that tip *D* of link *4* describes path *q*, when carrier *1* rotates, which is a rectangle with rounded corners.

3306	GEAR-CAM DIFFERENTIAL OSCILLATING MECHANISM	GrC ML

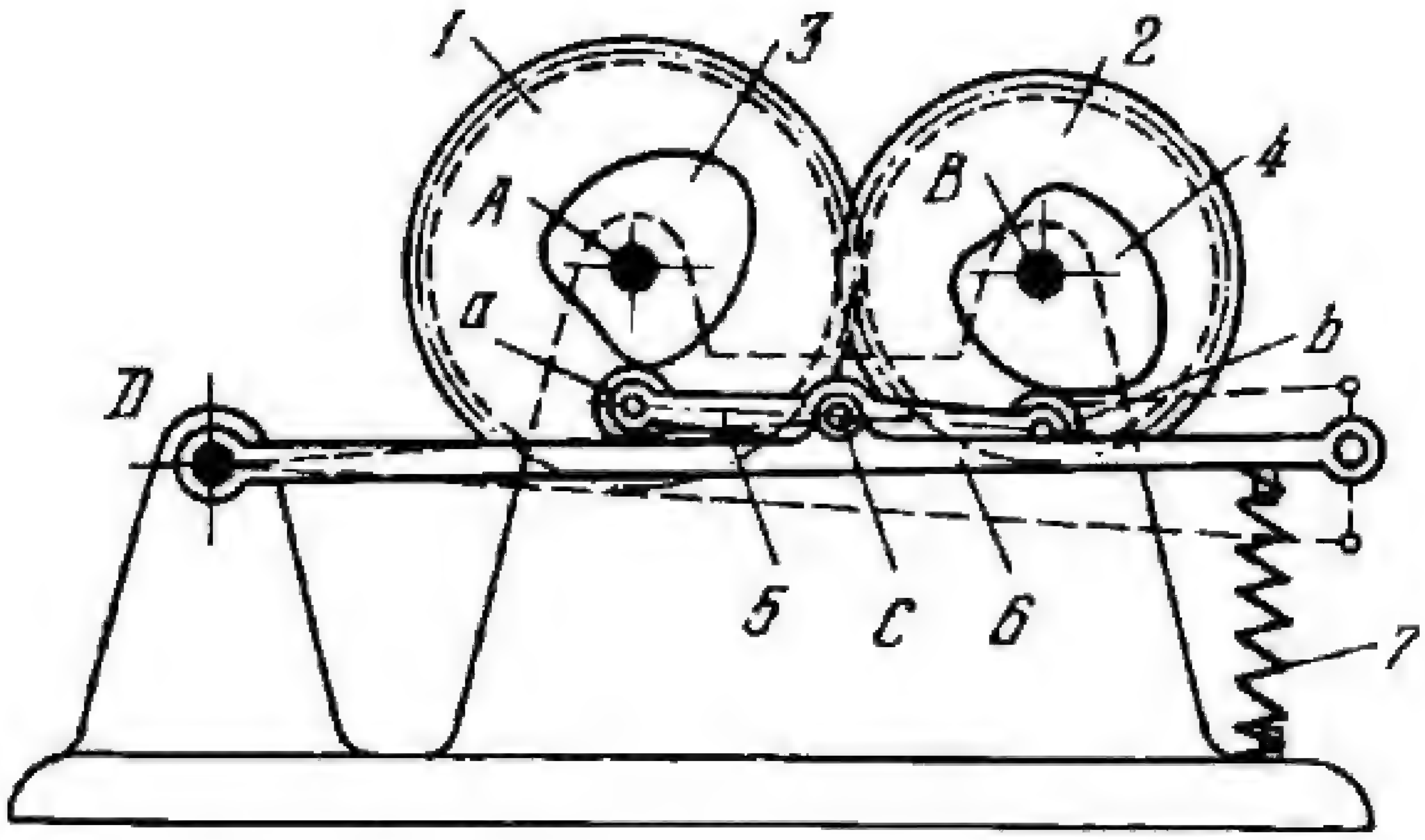


Gear *1* rotates about fixed axis *A* and meshes with planet gear *2*. Carrier *7* turns about axis *A* and is connected by turning pair *C* to planet gear *2* which meshes with internal gear *6*. Gear *6* turns about axis *A*. Rigidly attached to gear *1* is face cam *3* with profiled groove *a*. Follower *5* turns about fixed axis *B* and carries pin *4* which slides along groove *a*. Link *8* is connected by turning pairs *D* and *C* to follower *5* and to carrier *7*. When gear *1* rotates, driven internal gear *6* oscillates about axis *A*.

3307	GEAR-CAM MECHANISM WITH SWIVELLING MEMBERS	GrC ML



Gear *1* rotates about fixed axis *A* and is rigidly attached to lever *a* which is connected by turning pairs *C* and *D* to two identical members *3*. Members *3* carry rollers *4* which roll along the inside surface of fixed drum *5*. Gear *6* rotates about fixed axis *B*, meshes with gear *1* and is rigidly attached to cam *2*. When gear *1* rotates and a roller *4* reaches recess *b*, it is pushed into the recess by cam *2* and held there until member *3* is swivelled about axis *C* or *D*. In this way, each member *3* is swivelled through 180° once in each revolution about axis *A*.

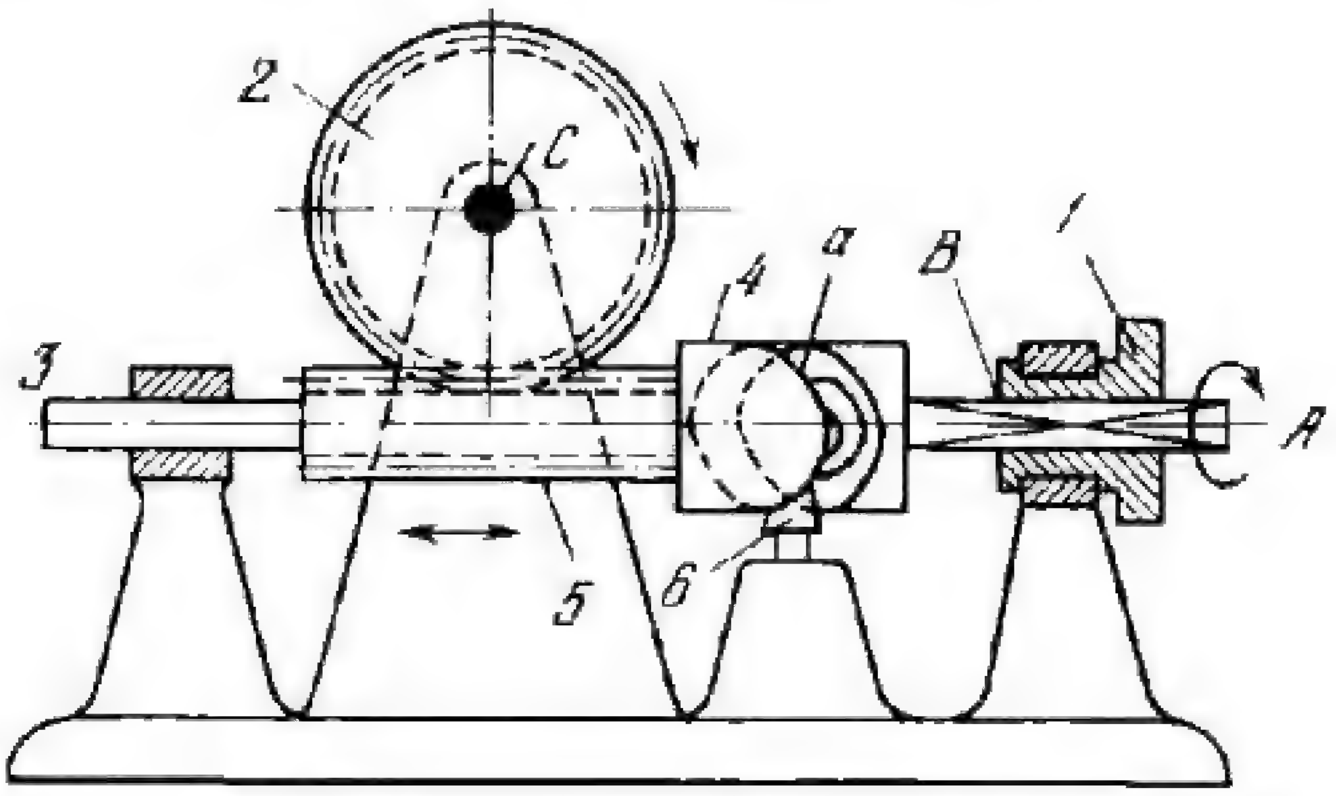


Gear *1* is rigidly attached to plate cam *3*, rotates about fixed axis *A* and meshes with gear *2* which is rigidly attached to plate cam *4* and rotates about fixed axis *B*. Link *5* is connected by turning pair *C* to follower *6* which turns about fixed axis *D*. Link *5* carries rollers *a* and *b* which roll along the contours of cams *3* and *4*. The number of teeth of gear *2* is $z_2 = z_1 - 1$, where z_1 is the number of teeth on gear *1*. Therefore, to each revolution of gear *1*, gear *2* makes

$$n_2 = \frac{z_1}{z_1 - 1} \text{ revolutions}$$

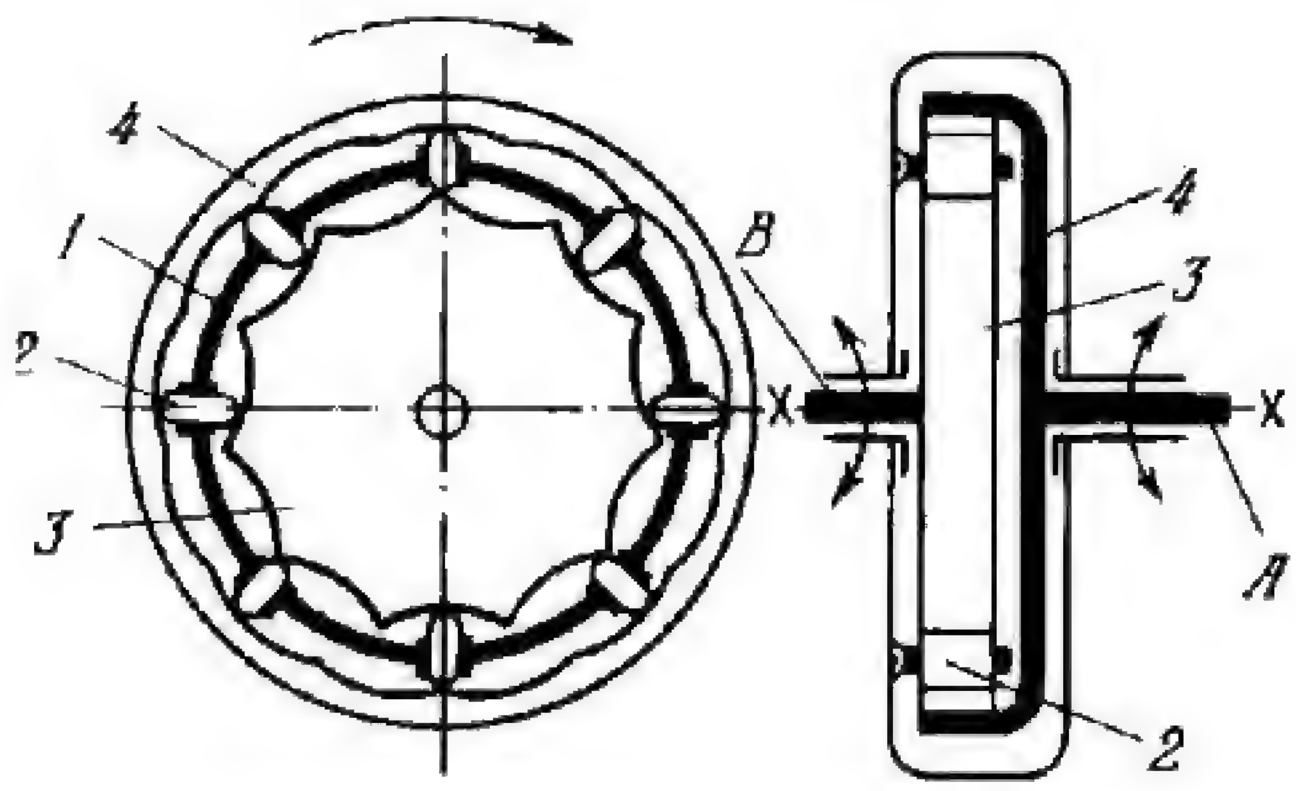
i.e. a full cycle of motion of the mechanism corresponds to $n_1 = z_1 - 1$ revolutions of gear *1*. Compression spring *7* holds rollers *a* and *b* in contact with cams *3* and *4*.

3309	WORM GEARING-CAM SPATIAL MECHANISM FOR SUPPLEMENTARY ROTATION	GrC ML



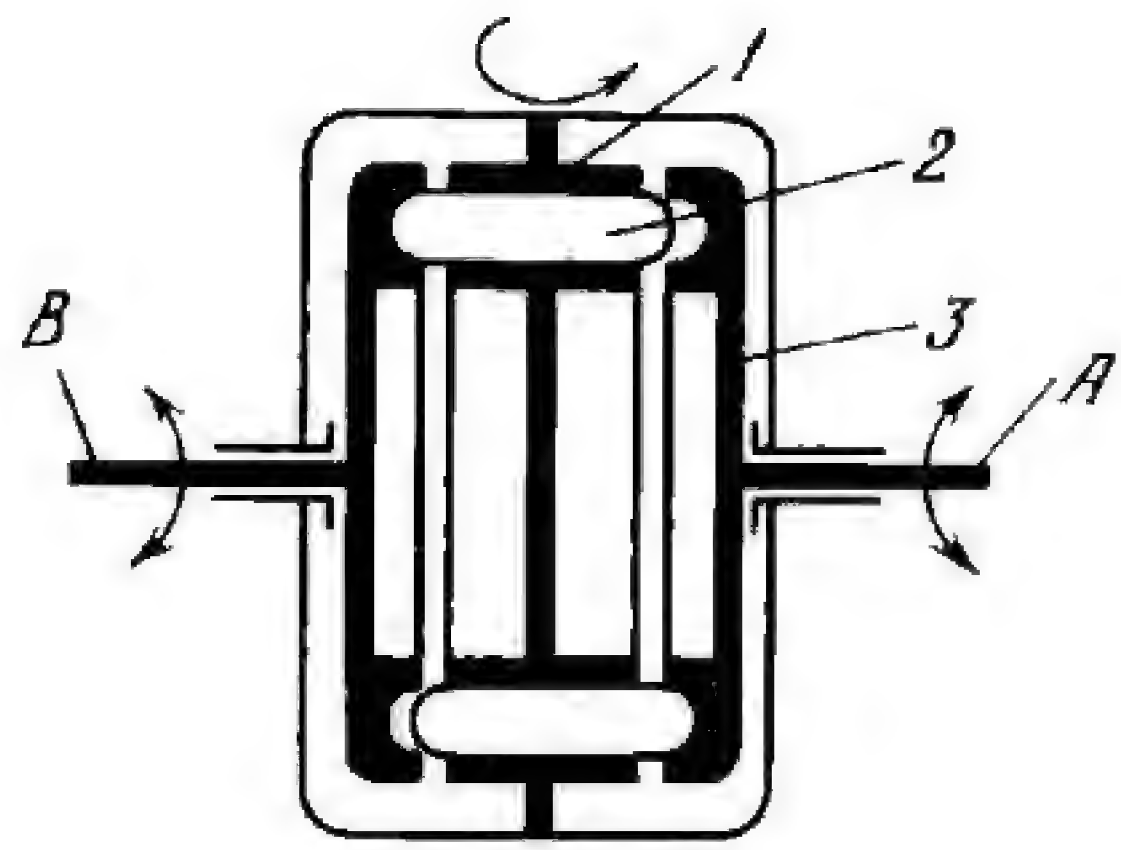
Sleeve *1* rotates about fixed axis *A* and is connected by sliding pair *B* to shaft *3* on which cylinder cam *4* and worm *5* are rigidly mounted. Cam *4* has continuous helical groove *a* with a helix angle equal to that of the thread on the worm. Groove *a* slides along roller *6* which rotates about a fixed axis. Worm *5* meshes with worm wheel *2* which rotates about fixed axis *C*. When sleeve *1* rotates, worm *5* has supplementary reciprocating motion along axis *A* so that worm wheel *2* rotates intermittently with supplementary motion in one direction followed by a dwell.

3310	GEAR-CAM MECHANISM OF A DIFFERENTIAL	GrC ML



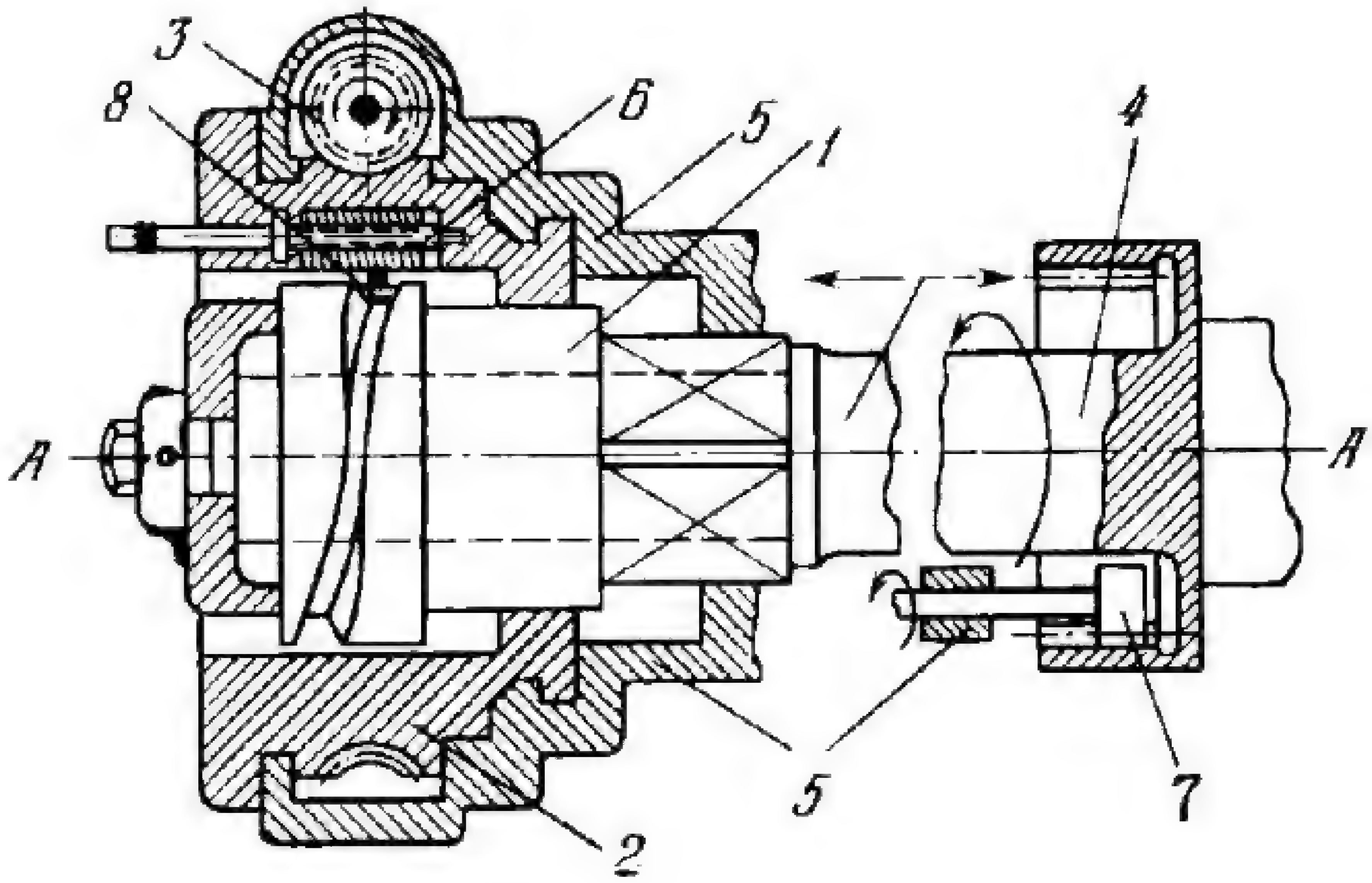
Cage *1* rotates about fixed axis *x-x* and has radial slots in which inserts (teeth) *2* can slide. Keyed to semiaxles *A* and *B* are cam disks *4* and *3*. Disk *3* has an external profiled (cam) surface and disk *4* a corresponding internal one. The number of cam lobes on disks *3* and *4*, and the number of inserts *2* are selected so that when cage *1* rotates, corresponding torques are transmitted to disks *3* and *4* and, consequently, to semiaxles *B* and *A* which, at the same time, can rotate at the same or different speeds, depending upon the load torque applied to each semiaxle.

3311	GEAR-CAM MECHANISM OF A DIFFERENTIAL WITH AXIAL INSERTS	GrC ML



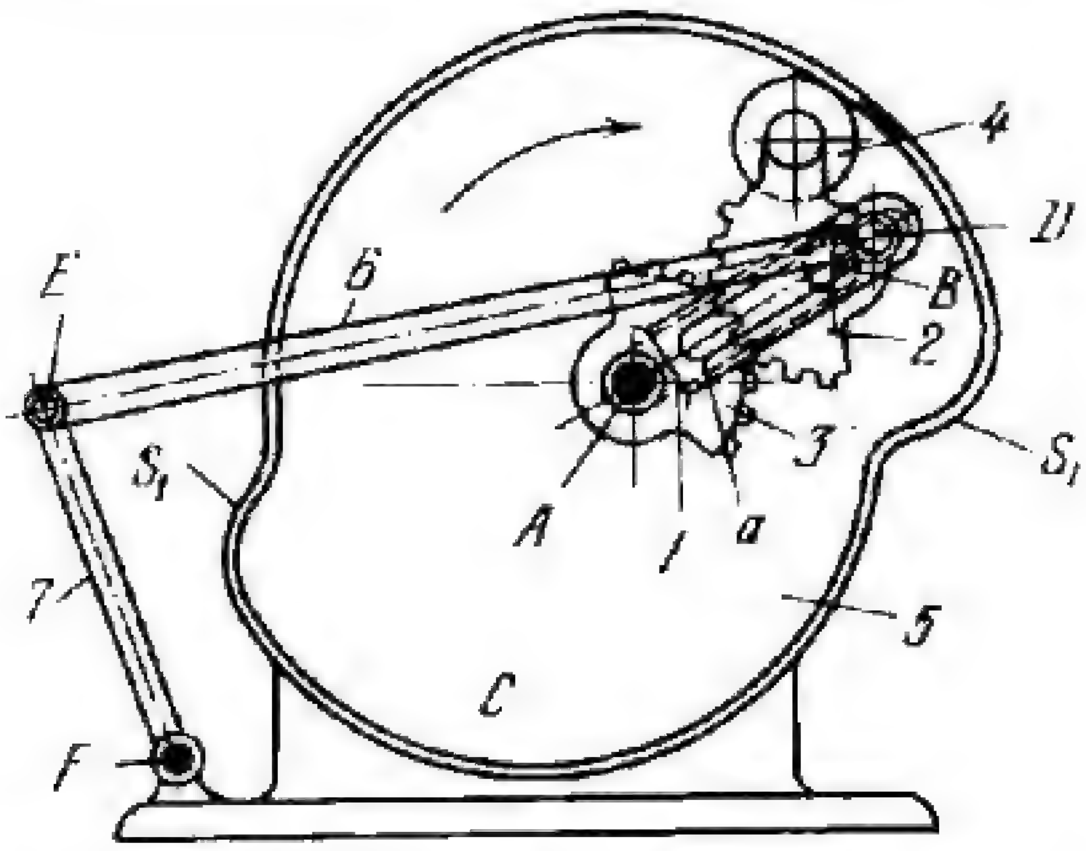
Rotation is transmitted to cage *1* which has slots in which inserts (teeth) *2* can slide in the axial direction. The outer ends of semiaxles *A* and *B* are connected to the driven links of the mechanism. Keyed to their inner ends and facing each other are cam disks *3* having profiled lobes on their inner (working) surfaces. The number of cam lobes on disks *3* and the number of inserts *2* are selected so that when cage *1* rotates, inserts *2* bear against the corresponding lobes of cam disks *3*, rotating them together with their semiaxles. If equal torque loads are applied to semiaxles *A* and *B*, their speeds are equal and the same as that of cage *1*. If one semiaxle is slowed down by higher load torque, inserts *2* are pushed by the lobes of the cam disk on this semiaxle toward the other disk and, by bearing against the corresponding lobes, increase the speed of the other semiaxle. If cage *1* is held stationary and one semiaxle is rotated, the other semiaxle rotates in the opposite direction.

3312	WORM GEARING-CAM MECHANISM	GrC ML



Roller *8* rotates about an axis rigidly attached to link *2* and rolls and slides along the groove of cylinder cam *1*. The square shank of cam *1* slides in a guide of base *5* so that cam *1* can only reciprocate without rotation. Driven link *4* can rotate with respect to cam *1*. When driving worm *3* rotates, link *2* also rotates, since its worm gear meshes with worm *3*, and cam *1* and link *4* reciprocate along axis *A-A*. When supplementary drive *7* is switched on, its pinion, meshing with the internal gear of link *4*, transmits rotation as well to this link. Screw *6* serves to adjust the position of roller *8* and cam *1* with respect to link *2*.

3313	**FIXED-CAM SEGMENT GEARING MECHANISM**	GrC ML



Link *1* rotates about fixed axis *A* and is connected by turning pair *B* to segment gear *2* which meshes with segment gear *3*, rotating freely about axis *A*. Segment gear *3* has a crank with slot *a* along which axis *D* can be adjusted. Connecting rod *6* is connected by turning pairs *D* and *E* to gear *3* and to link *7* which turns about fixed axis *F*. When roller *4*, carried by segment gear *2*, reaches a portion S_1 of internal fixed cam *5*, segment gear *2* is turned about axis *B* and it turns segment gear *3* with its crank. This transmits accelerated motion to connecting rod *6* and link *7*.

3314	**GEAR-CAM FIXED-RACK MECHANISM**	GrC ML

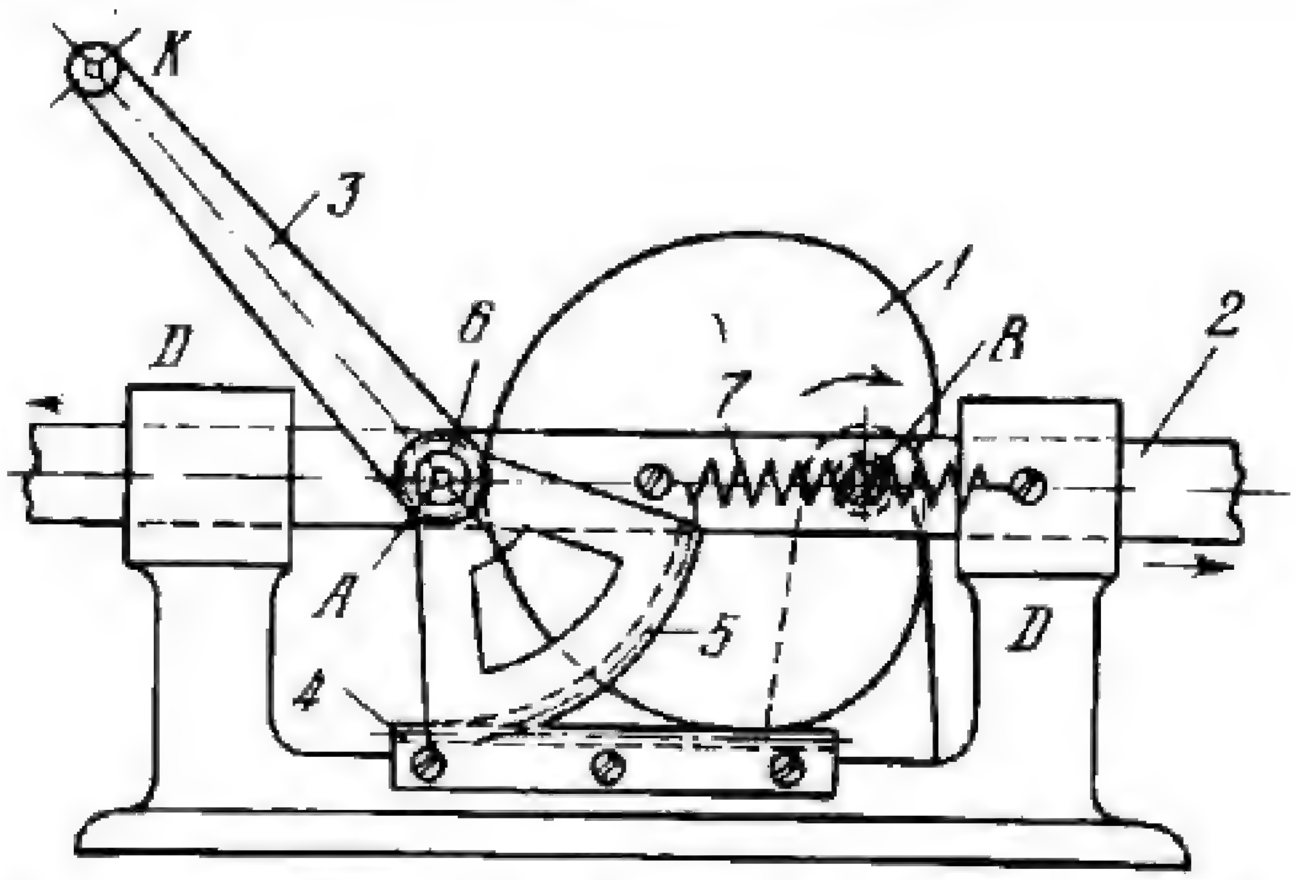
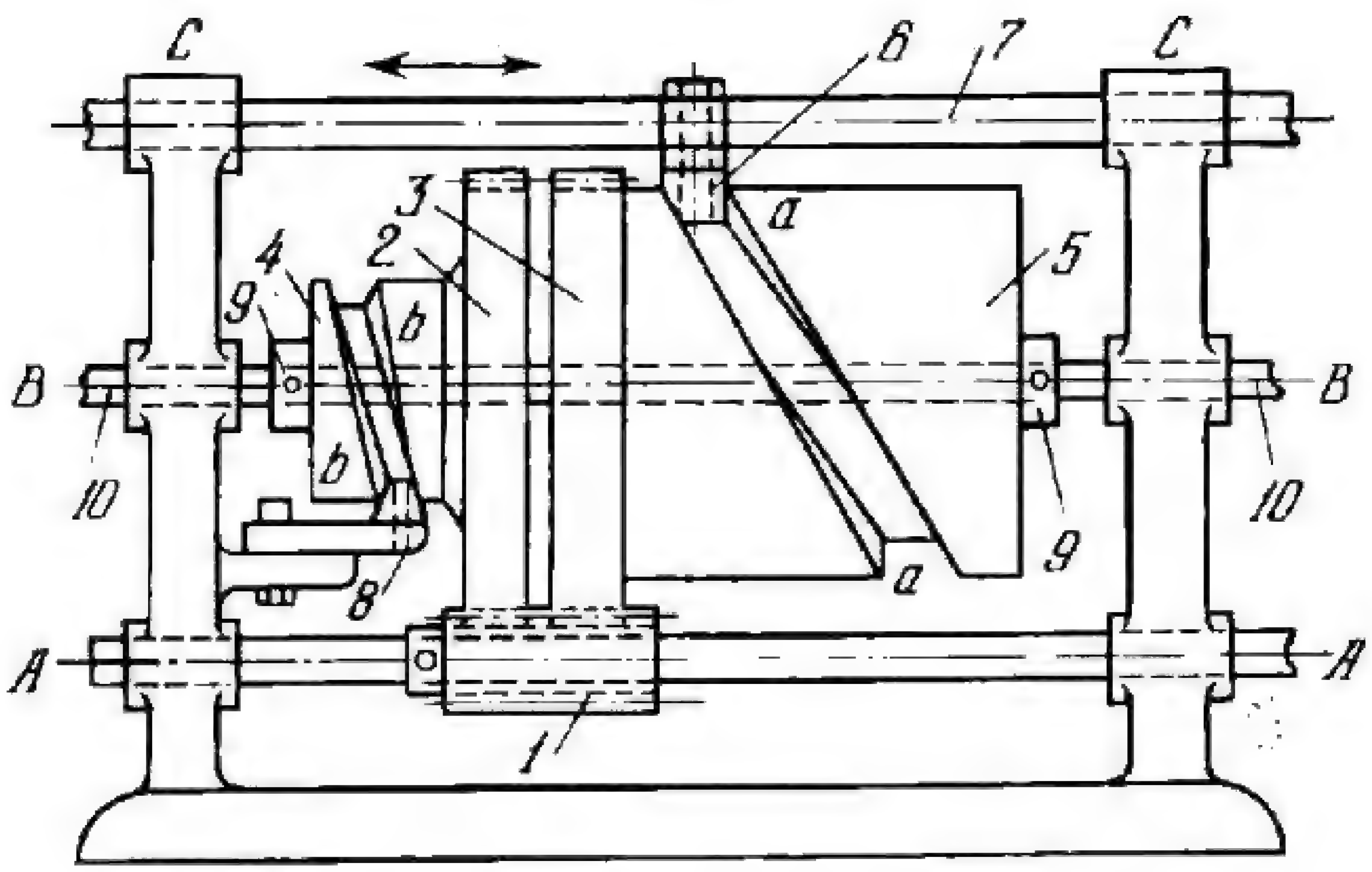


Plate cam *1* rotates about fixed axis *B*. Follower *2* reciprocates in fixed guides *D-D* and carries roller *6* which rolls along the contour of cam *1*. Link *3* is connected by turning pair *A* to follower *2* and has gear segment *5* which meshes with fixed rack *4*. When cam *1* rotates, point *K* of link *3* describes a prolate cycloid. The profile of cam *1* consists of two Archimedean spirals so that points *A* and *K* travel at constant velocity. Roller *6* is held in contact with cam *1* by spring *7*.

3315	GEAR-CAM SPATIAL AUTOMATIC STROKE-CHANGING MECHANISM	GrC ML



Driving pinion *1* rotates about fixed axis *A-A* and meshes with gears *2* and *3* which rotate about fixed axis *B-B* and have slightly different numbers of teeth. Rigidly attached to gears *2* and *3* are cylinder cams *4* and *5*. Bar *7* is reciprocated in fixed guides *C-C* by cam *5* along whose groove *a-a* roller *6* of the bar rolls and slides. Gears *2* and *3*, together with cams *4* and *5*, rotate freely on shaft *10*, being confined between stopper rings *9*. Roller *8* rotates about an axis rigidly attached to the base and rolls and slides along groove *b-b* of cam *4*. Shaft *10* can reciprocate axially with gears *2* and *3* and cams *4* and *5*. Owing to the different number of teeth on gears *2* and *3*, the relative positions of cams *4* and *5* continually vary and the stroke of bar *7* increases when shaft *10* and bar *7* move in the same direction and decreases when they move in opposite directions.

3316	GEAR-CAM MECHANISM FOR PERIODICALLY VARYING MOTION	GrC ML

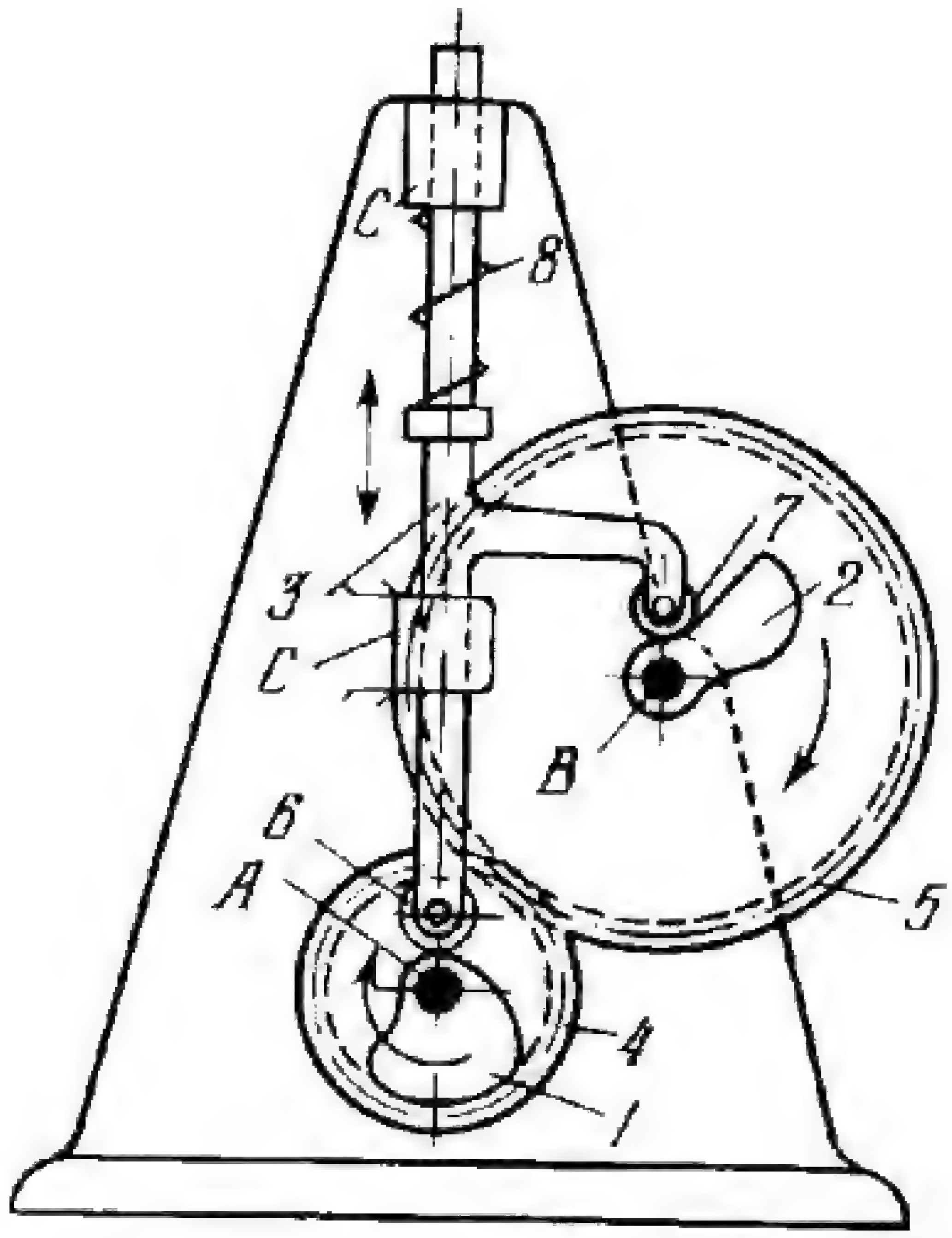


Plate cam *1* rotates about fixed axis *A* and is rigidly attached to gear *4* which meshes with gear *5*. Cam *2* is rigidly attached to gear *5* which rotates about fixed axis *B*. Gear *5* has twice as many teeth as gear *4*. Follower *3* reciprocates in fixed guides *C*-*C* and carries two rollers, *6* and *7*, which roll along the contours of cams *1* and *2*. Cams *1* and *2* alternately actuate rollers *6* and *7*, transmitting complex periodically varying motion to follower *3*. Roll *6* or *7* is held in contact with cam *1* or *2* by spring *8*.

3317	GEAR-CAM SLOTTED-LINK DWELL MECHANISM	GrC D

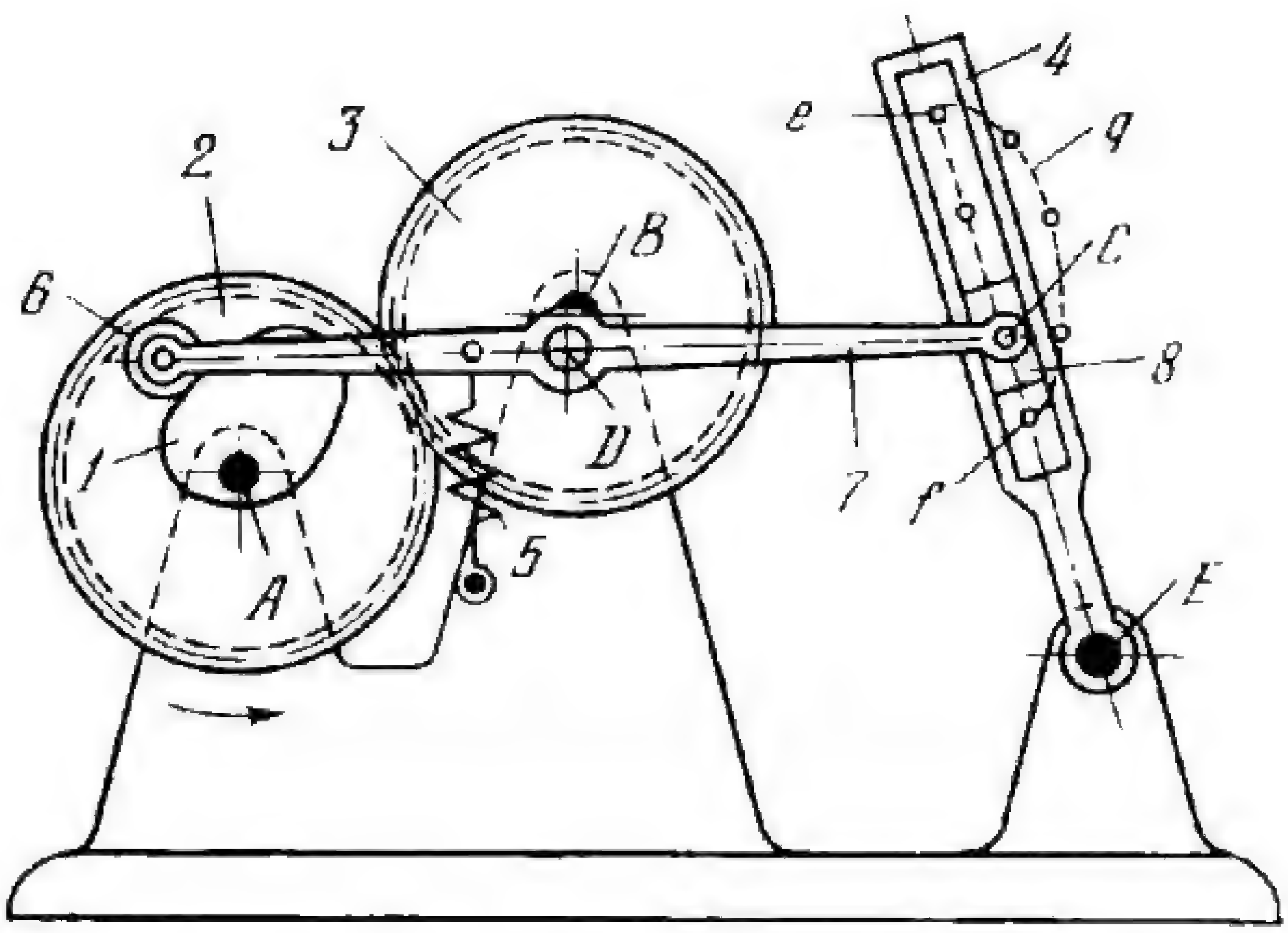
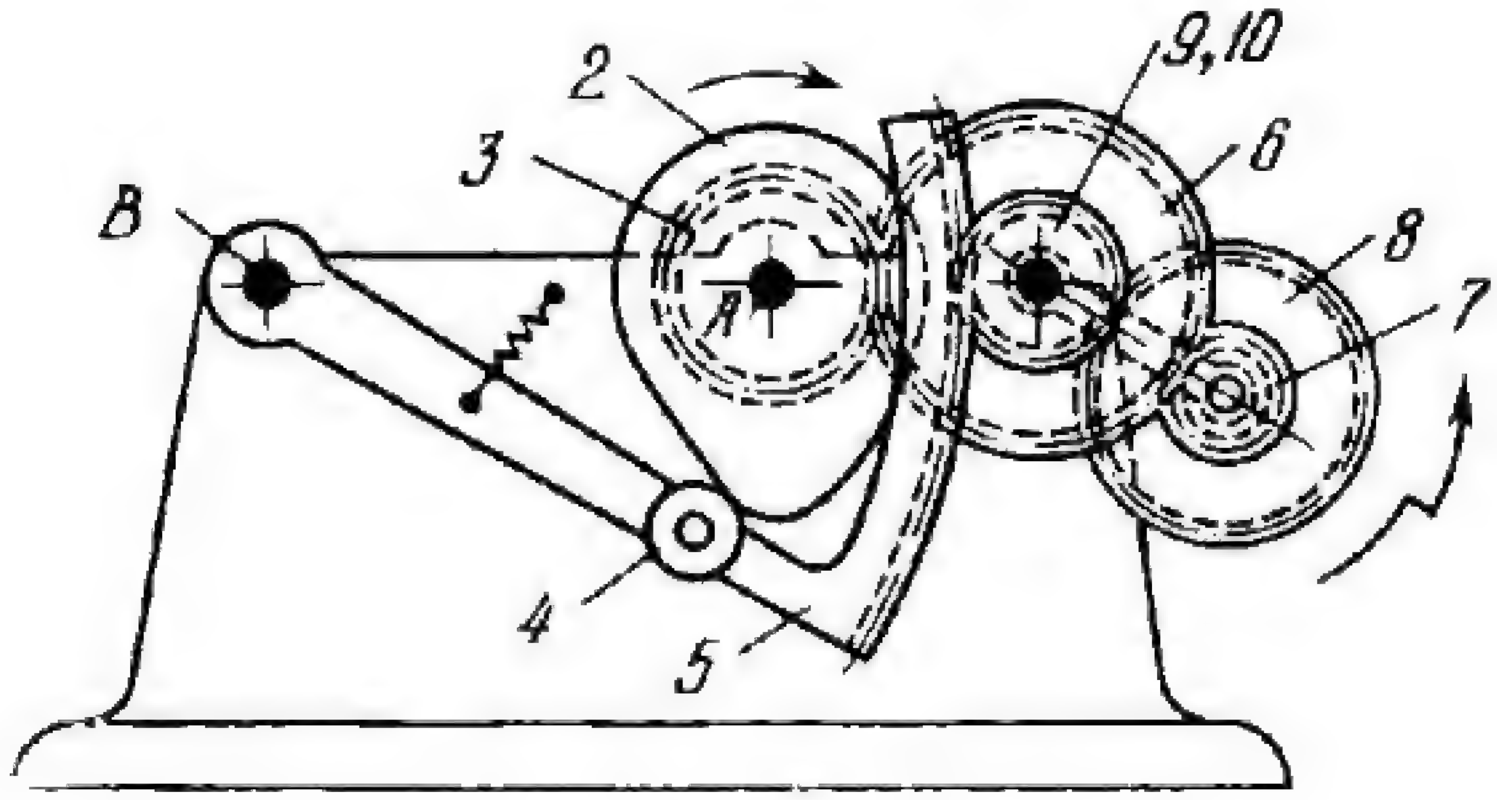


Plate cam *1* rotates about fixed axis *A* and is rigidly attached to gear *2* which meshes with gear *3*. Gear *3* rotates about fixed axis *B* and is connected by turning pair *D* to link *7* which carries roller *6*, rolling along the contour of cam *1*. Link *7* is connected by turning pair *C* to slider *8*, moving along the slot of link *4* which turns about fixed axis *E*. The working surface of cam *1* is designed so that point *C* of link *7* describes path *q* of which portion *e-f* is a straight line. Consequently, slotted link *4* has a dwell while point *C* moves along portion *e-f* of path *q*. Roller *6* is held in contact with cam *1* by spring *5*.

3318	GEAR-CAM DIFFERENTIAL DRIVEN-CARRIER DWELL MECHANISM	GrC D



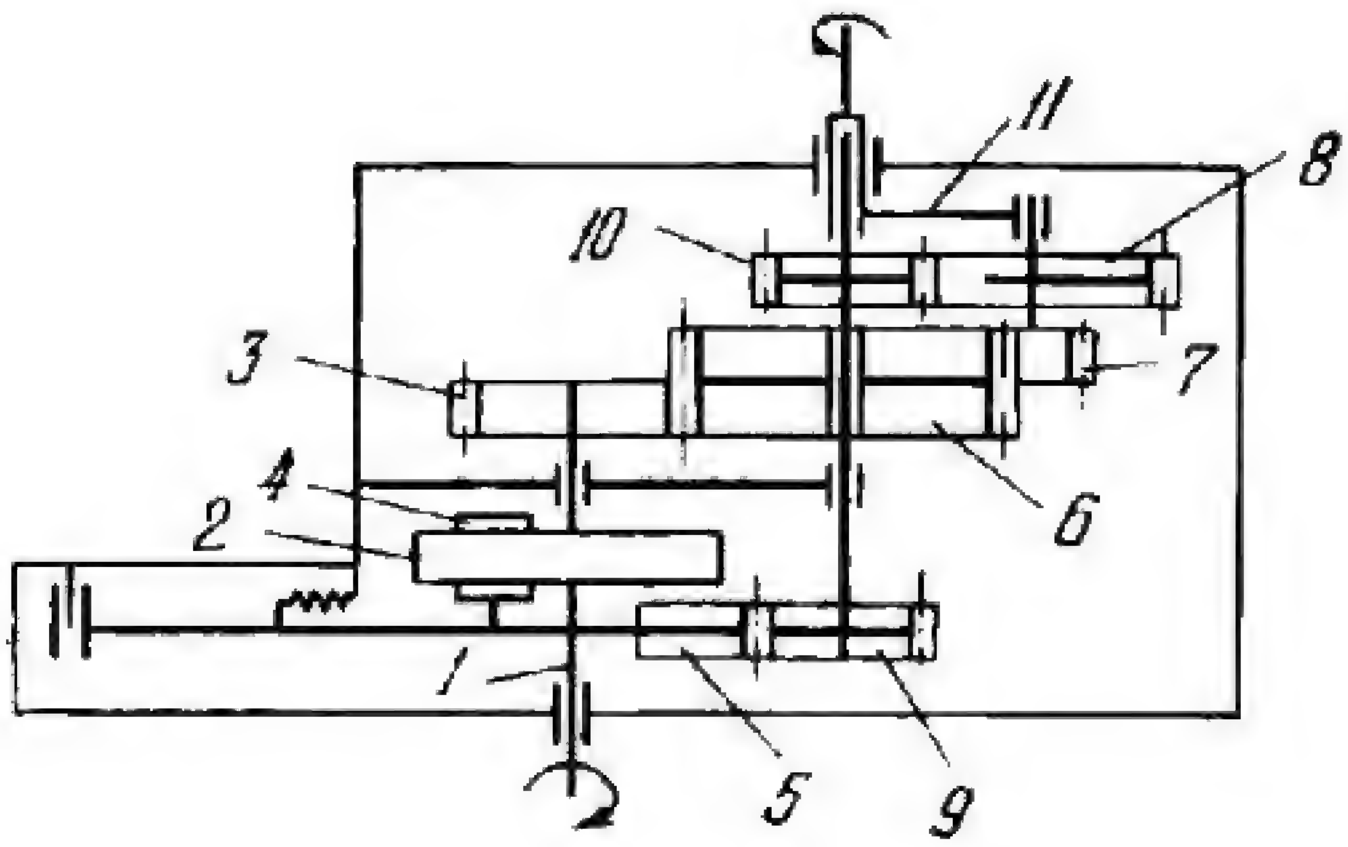
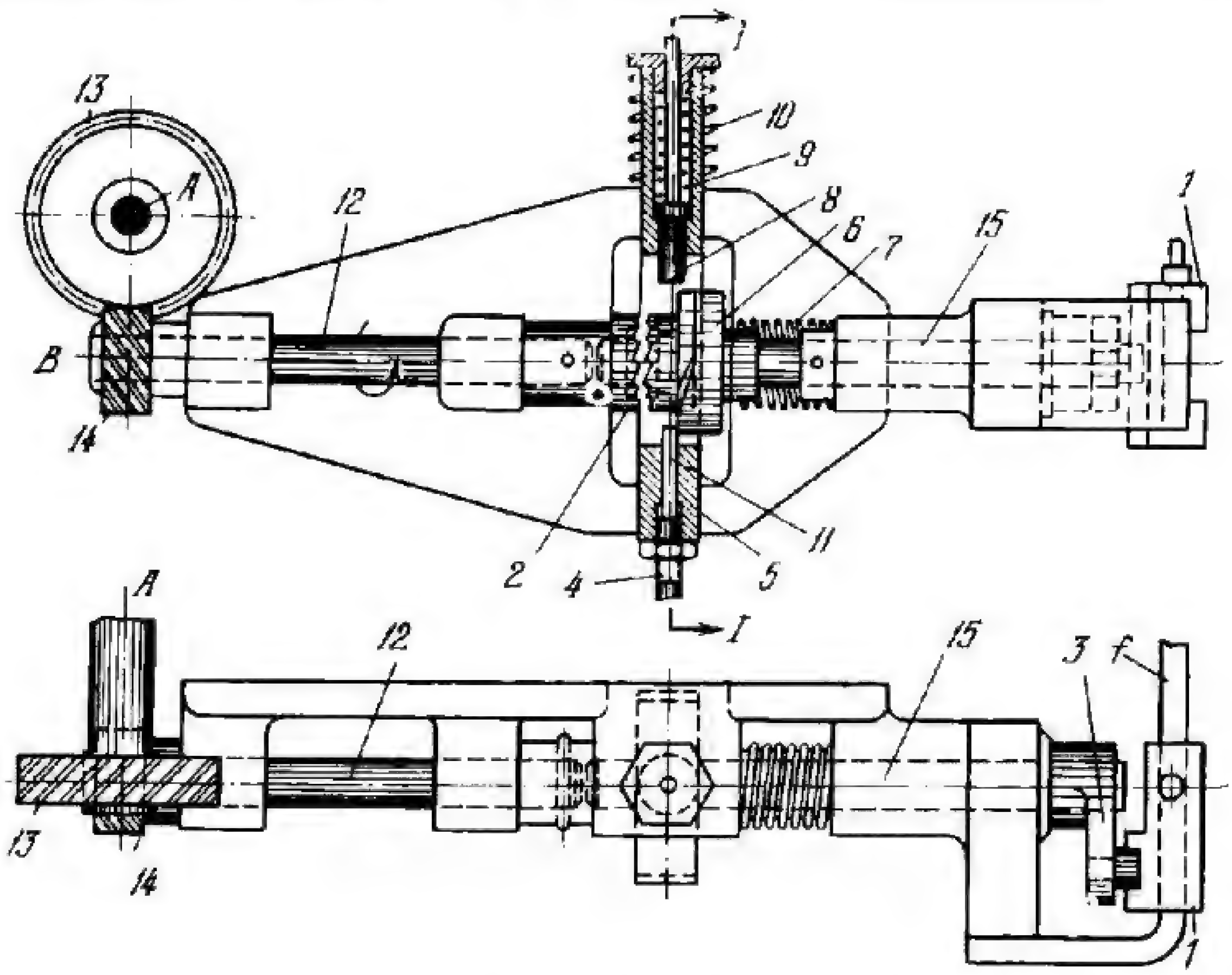
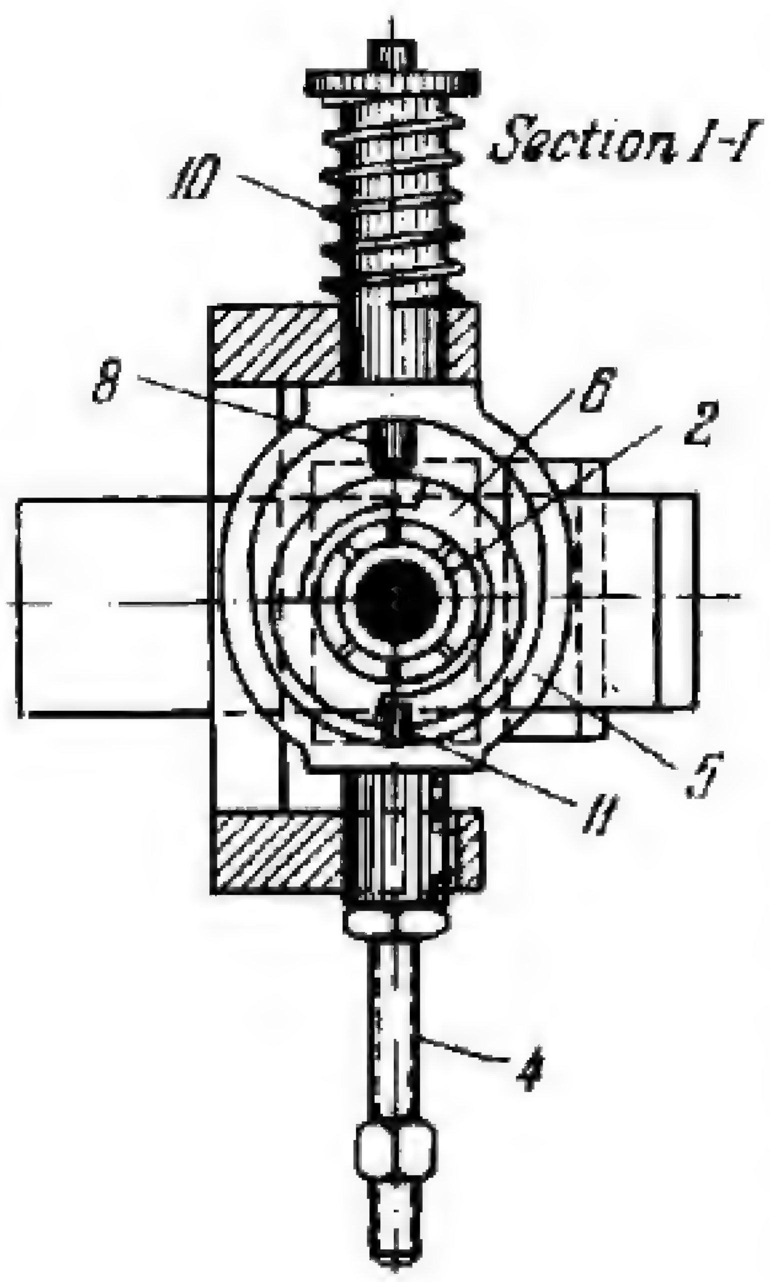


Plate cam *2* rotates about fixed axis *A* of shaft *1* and is rigidly attached to gear *3*. Segment gear *5* turns about fixed axis *B* and carries roller *4* which rolls along the contour of cam *2*. Rotation is transmitted to gear *7* from shaft *1* through gears *3* and *6*. Rotation is transmitted to gear *8* from shaft *1* through cam *2*, segment gear *5* and gears *9* and *10*. When shaft *1* rotates, gears *7* and *8* roll around gears *6* and *10*, rotating carrier *11*. The working surface of cam *2* is designed so that carrier *11* rotates intermittently with dwells.

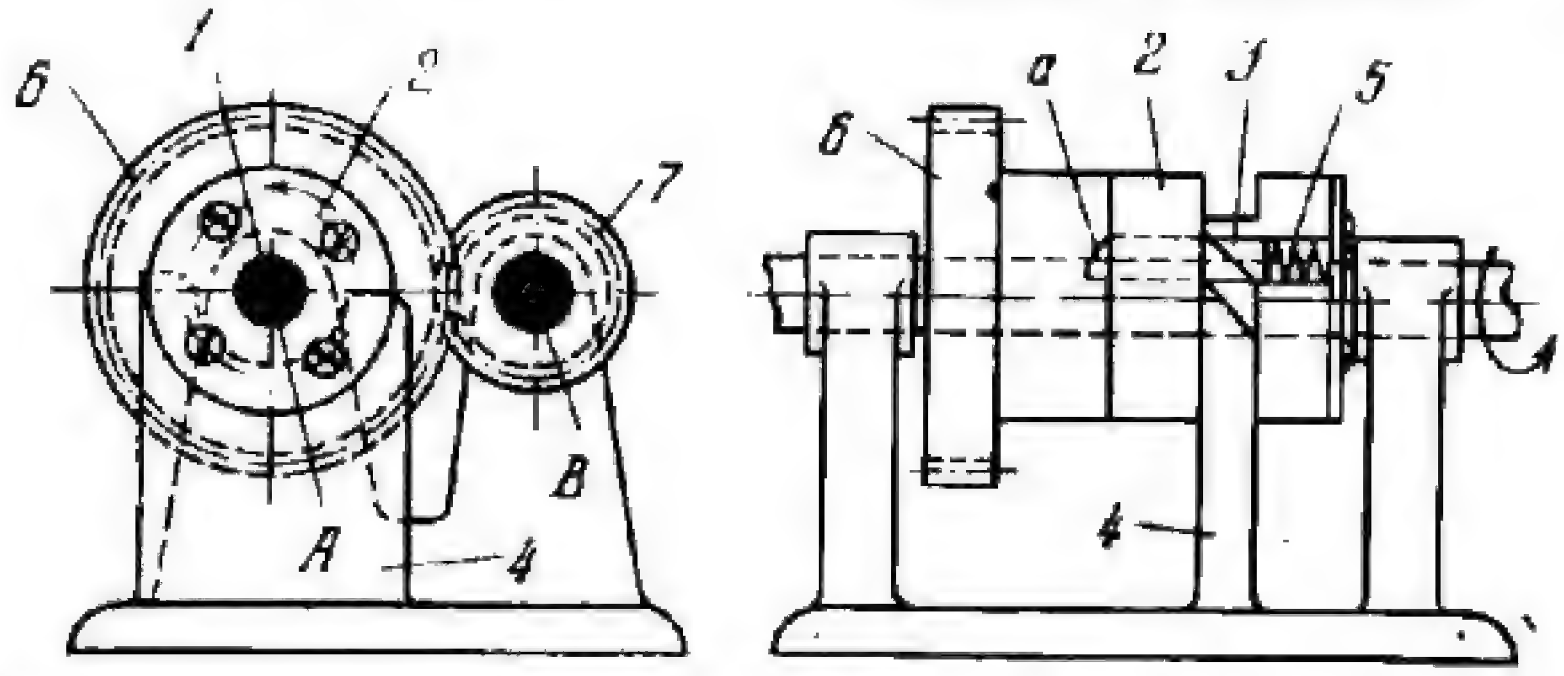
3319	GEAR-CAM SPATIAL INTERMITTENT-MOTION MECHANISM	GrC D





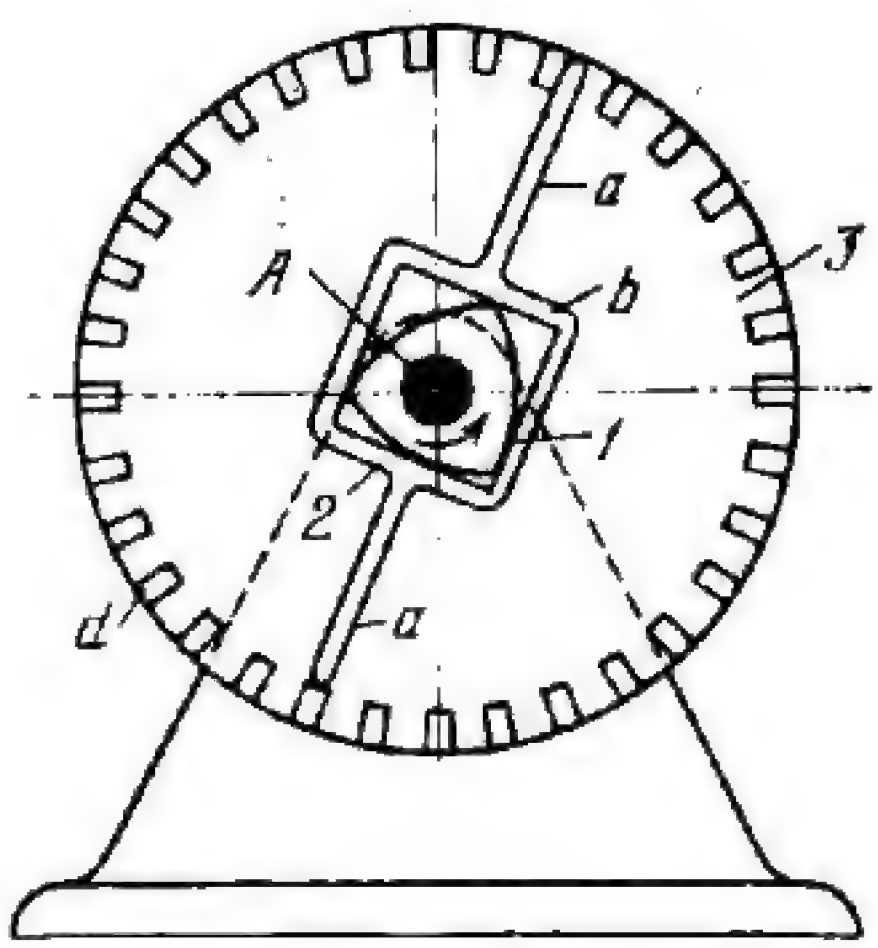
Helical gear *13* rotates about fixed axis *A* and meshes with helical gear *14* which is keyed to shaft *12* and rotates about fixed axis *B*. When shaft *12* rotates continuously, an intermittent reciprocating motion with dwells at the ends of each stroke is transmitted to slide *1* through shaft *15* and crank *3*, due to the periodical engagement and disengagement of clutch *2*. The clutch is engaged by a clock mechanism (not shown). When rod *4* of yoke *5* is pulled downward by the action of the clock mechanism, cam *6* together with the right-hand member of clutch *2* is shifted by spring *7* along feather keys on shaft *15*, thereby engaging the right- and left-hand members of clutch *2* so that shaft *15* begins to rotate. As it turns, cam *6* releases upper pin *8* which drops down under the action of compressed spring *9* and makes contact with the cam contour, forcing back the right-hand member and disengaging clutch *2* so that shaft *15* stops after turning 180°. When the clock mechanism releases rod *4*, yoke *5* is raised by spring *10* and, before pin *8* moves out of contact with cam *6*, it is engaged by lower pin *11* which returns to its initial position in which clutch *2* is disengaged. Thus, shaft *15* turns intermittently, through 180° each time, and slide *1* reciprocates along fixed guide *f* with dwells at the ends of each stroke.

3320	GEAR-CAM SPATIAL DWELL MECHANISM	GrC D



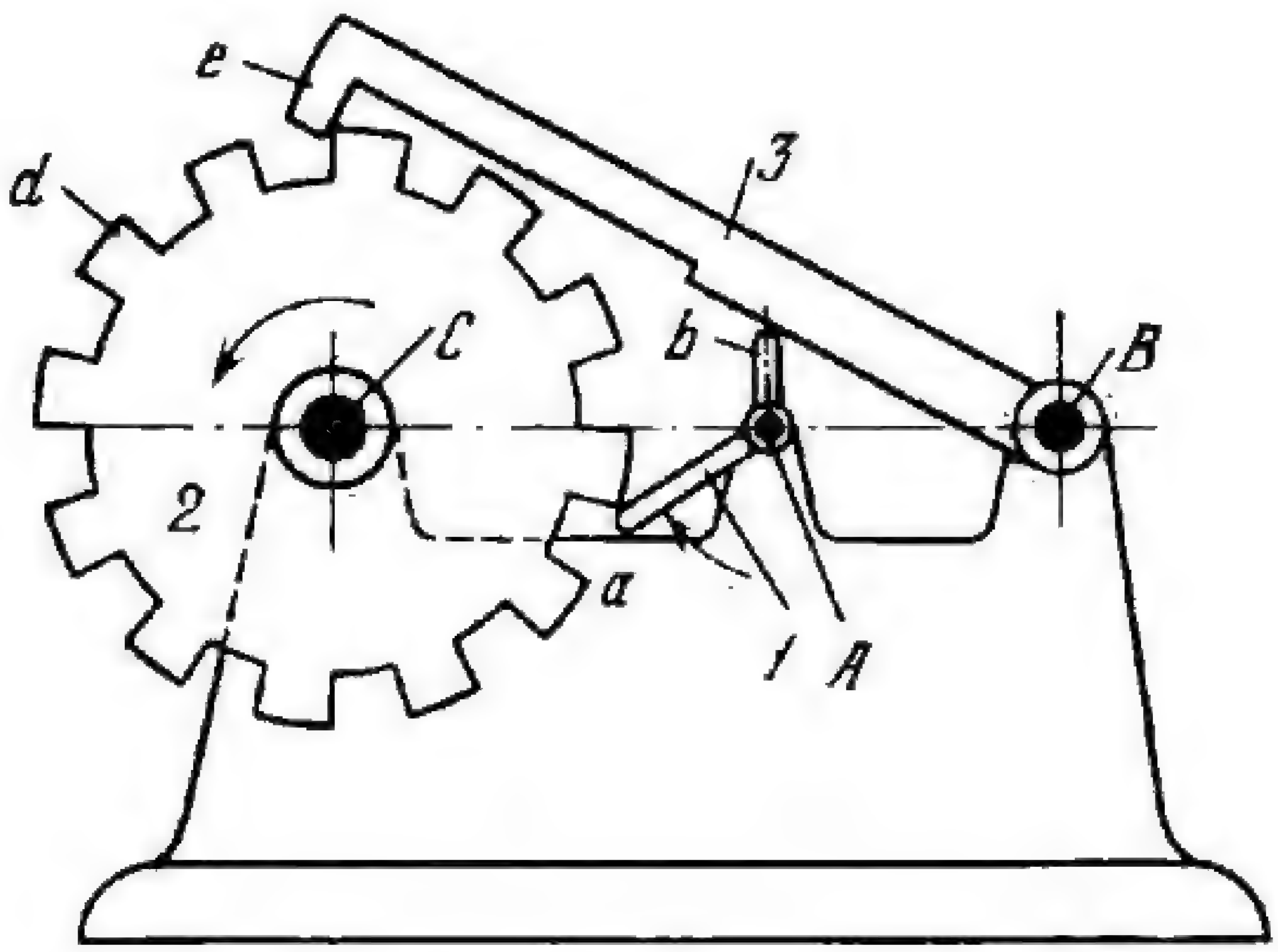
Gear *6* rotates freely on shaft *1* about fixed axis *A* and meshes with gear *7* which rotates about fixed axis *B* and has one half as many teeth as gear *6*. Sleeve *2* is keyed to shaft *1* and has sliding pawl *3* whose end *a* is forced by spring *5* into engagement with gear *6* so that the gear rotates together with sleeve *2* and shaft *1*. Rigidly attached to the base is cam member *4* whose profiled working surface disengages pawl *3* from gear *6* after each half revolution of the gear. Thus, when shaft *1* rotates continuously, gear *7* rotates intermittently with dwells. Owing to the tooth ratio of gears *6* and *7*, the dwell and rotation periods of gear *7* are equal to each other and correspond to one half revolution of gear *6*.

3321	GEAR-CAM DWELL MECHANISM	GrC D



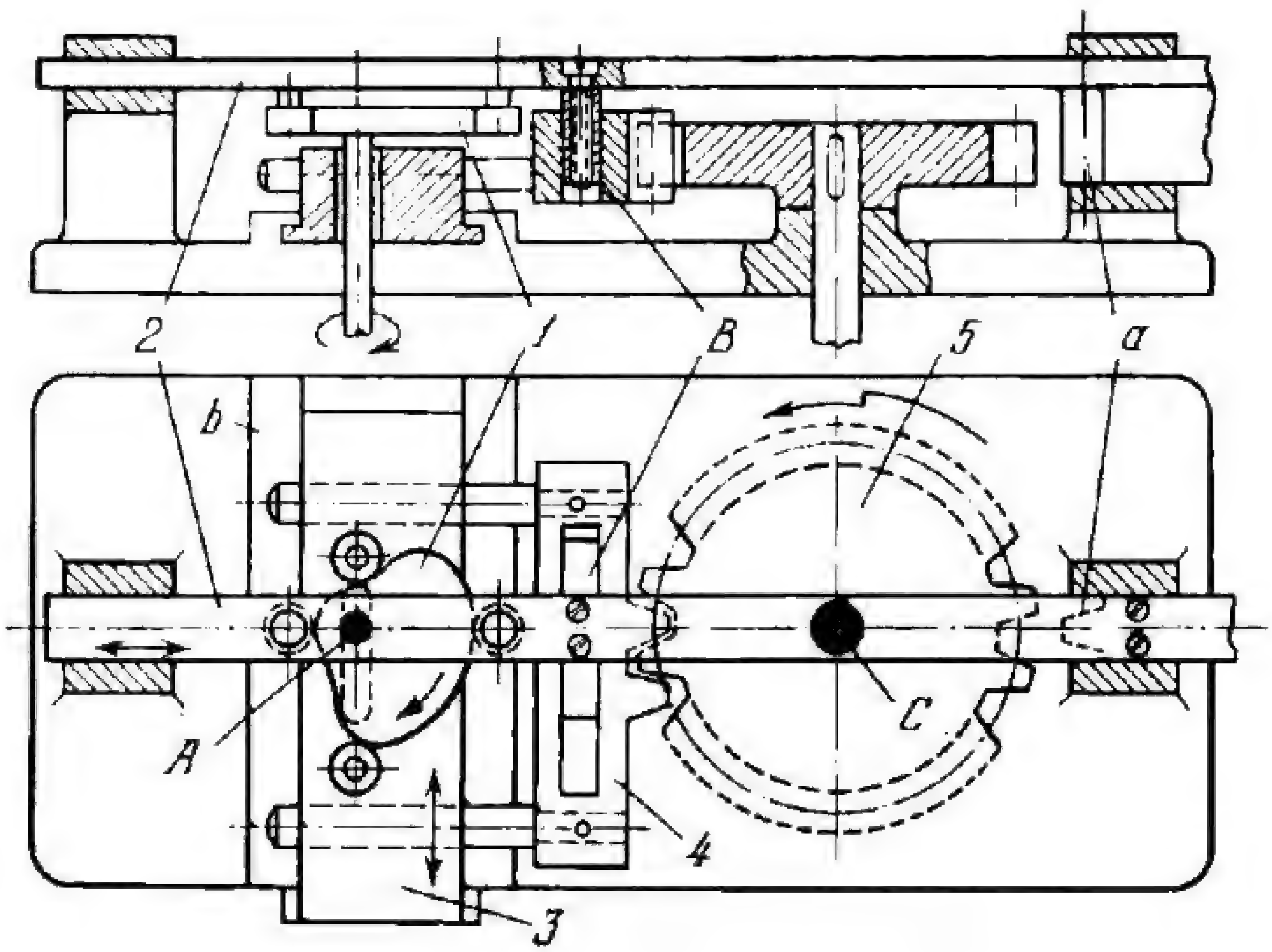
Constant-breadth cam *1* rotates about fixed axis *A* and is enclosed by square opening *b* of link *2* which has pawls *a* at its ends. Link *3* rotates about axis *A* and has teeth *d*. When cam *1* rotates, pawls *a* engage teeth *d* and rotate link *3* intermittently with dwells. When one pawl *a* engages a tooth *d*, the opposite pawl *a* runs up against the top of a tooth.

3322	GEAR-CAM DWELL MECHANISM	GrC D



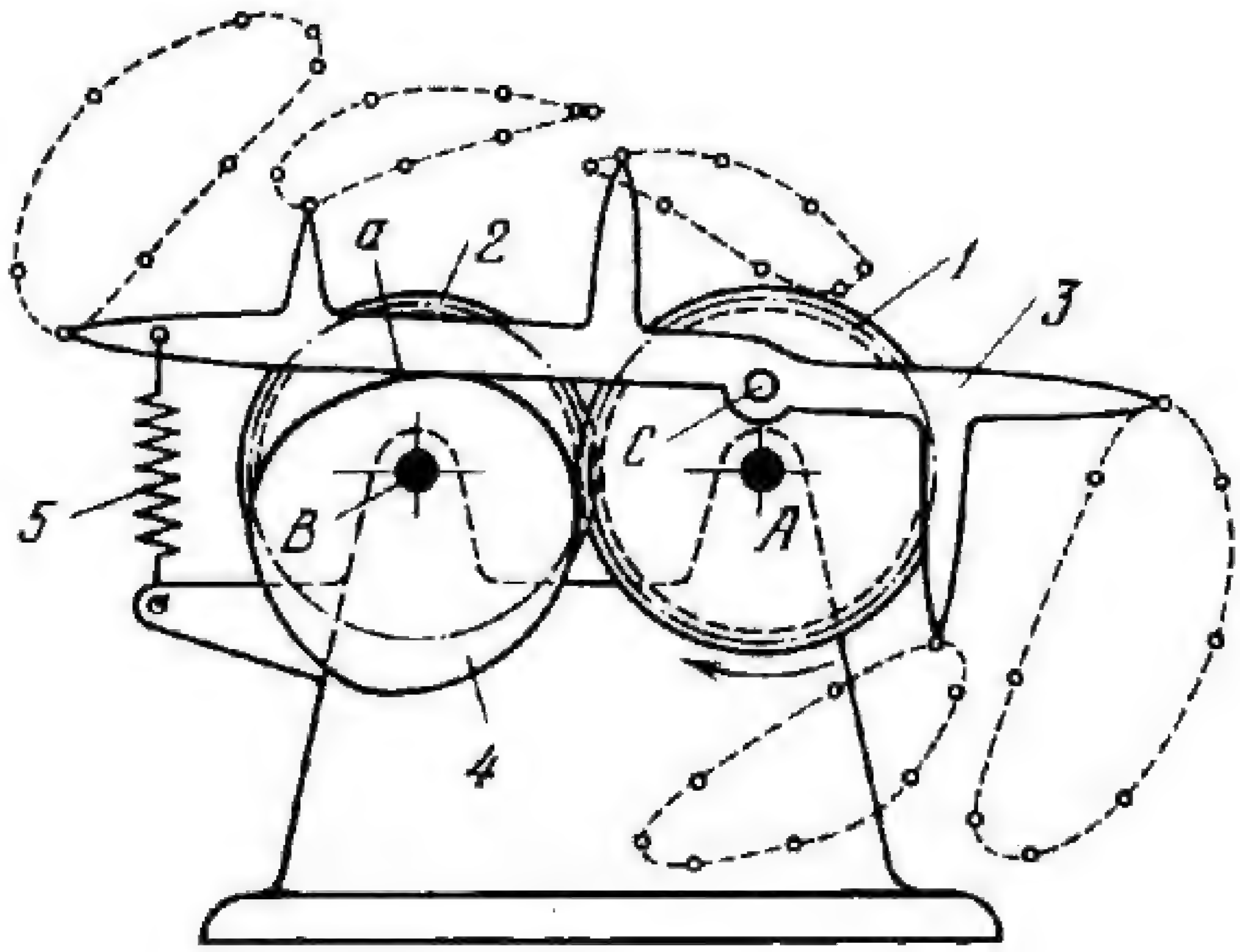
Cam *1*, consisting of two fingers, *a* and *b*, rotates about fixed axis *A*. Locking pawl *3* turns about fixed axis *B* and has lug *e* which enters the spaces between teeth *d* of wheel *2*. Wheel *2* rotates about fixed axis *C*. When cam *1* rotates, its finger *a* turns wheel *2*, one tooth at a time. Simultaneously, finger *b* raises pawl *3* to allow wheel *2* to turn. Pawl *3* locks wheel *2* against unintentional rotation during its dwell periods.

3323	GEAR-CAM DWELL MECHANISM	GrC D



Constant-diameter cam *1* rotates about fixed axis *A* and reciprocates follower *2* and slide *3* in fixed guides. As cam *1* rotates it first advances rack *4* into engagement with gear *5* which rotates about fixed axis *C*. Then slide *3*, upon further rotation of cam *1*, moves rack *4* crosswise, thereby turning gear *5*. As cam *1* continues to rotate, it moves follower *2* in the reverse direction, disengaging rack *4* from gear *5* and advancing tooth *a*, rigidly attached to follower *2*, into a tooth space of gear *5*. This locks gear *5* against unintentional rotation during its dwell period. Finally, cam *1* returns slide *3* and rack *4* to the initial position.

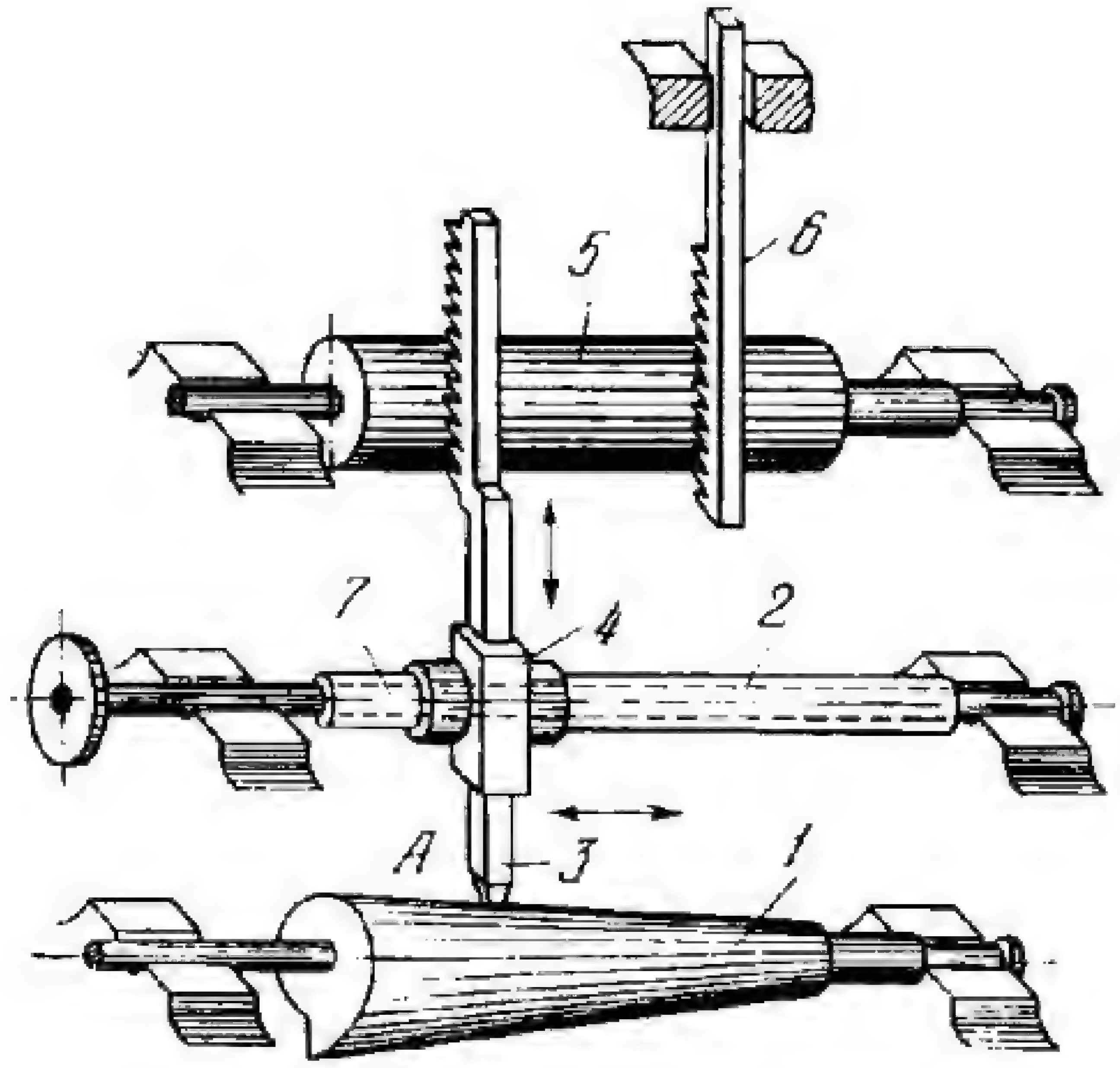
3324	GEAR-CAM MECHANISM FOR TRACING COMPLEX CONNECTING-ROD CURVES	GrC Ge



Gear *1* rotates about fixed axis *A* and meshes with gear *2* which rotates about fixed axis *B*. Rigidly attached to gear *2* is plate cam *4*. Driven connecting rod *3* is connected by turning pair *C* to gear *1* and its lower surface contacts contour *a* of cam *4*. When gear *1* rotates, points of connecting rod *3* describe complex connecting-rod curves whose shape depends upon the dimensions of the links, their location with respect to one another, and to the profile of cam *4*. Connecting rod *3* is held in contact with cam *4* by spring *5*.

4. MECHANISMS FOR MATHEMATICAL OPERATIONS
(3325 through 3328)

3325	GEAR-CAM SPATIAL MECHANISM FOR REPRESENTING A FUNCTION OF TWO INDEPENDENT VARIABLES	GrC MO

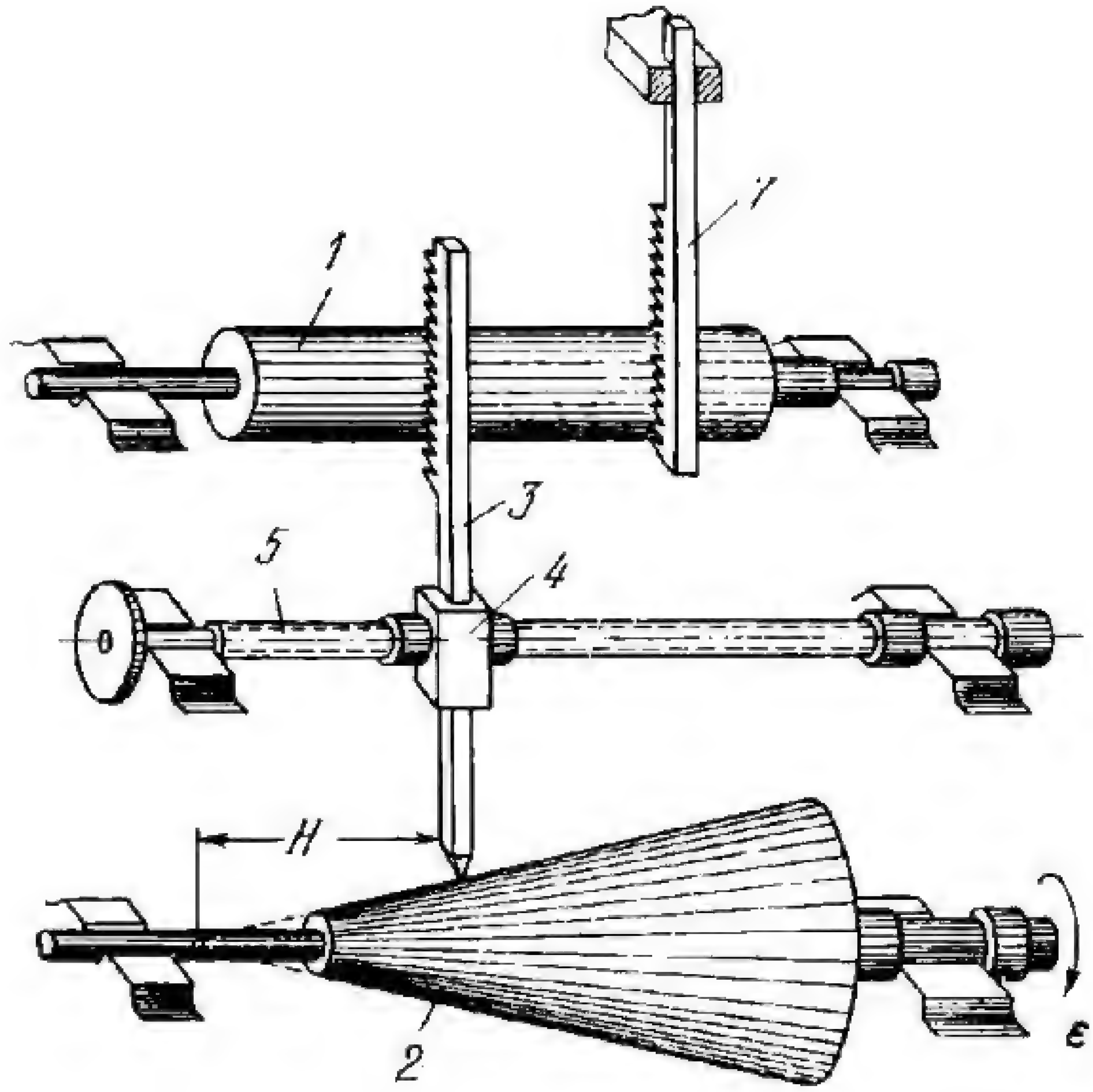


The mechanism serves to represent rectilinear translational motion given as a function of two independent variables. The position of driven link *6* is a function of the position of driving cam *1*:

$$z = f\ (x_A,\ \alpha)$$

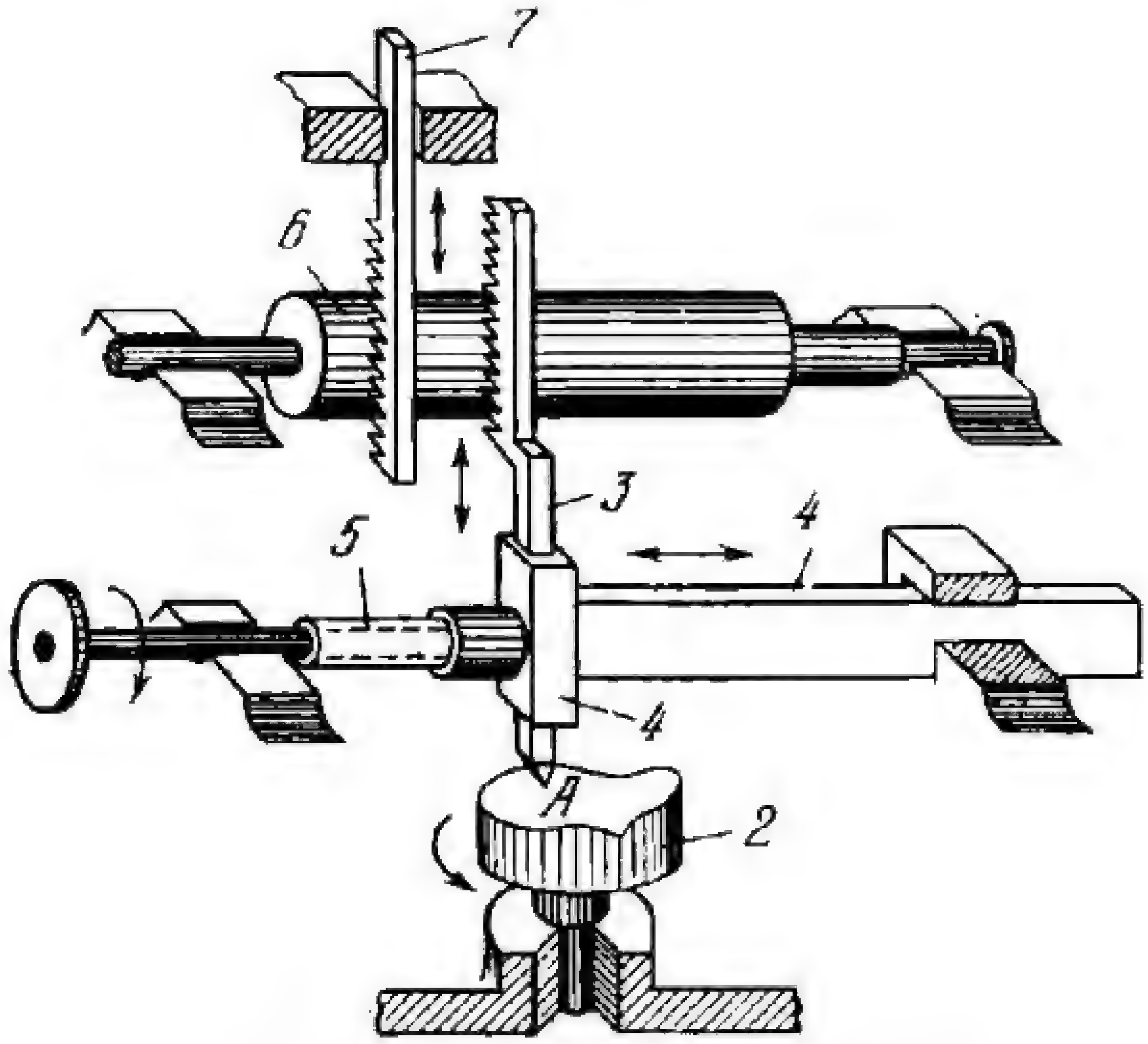
where x_A is the coordinate of point of contact A of follower *3* with cam *1*, and α is the angle of rotation of cam *1*. Follower *3* has simultaneous translational motions up or down and right or left. Screw *7* is rotated according to the law of variation of x_A. Follower *3* has a gear rack which rotates gear *5* an amount proportional to z, and gear *5* traverses rack *6*. Rack *6* travels in fixed guides according to the equation $z = f\ (x_A,\ \alpha)$.

3326	GEAR-CAM SPATIAL COORDINATOR MECHANISM	GrC MO



The mechanism serves to convert rectangular (Cartesian) coordinates into cylindrical coordinates. Link *2* is a conoid with the surface $r = H \cot \varepsilon$. The intersection of this surface with a plane passing through the axis of the conoid is a straight line. The intersection of the conoid with a plane perpendicular to its axis is a curve with the polar equation: $r = \cot \varepsilon$, where ε corresponds to the chosen value of H. Angle ε is entered as the angle of rotation of the conoid, and height H by turning screw *5*. The required coordinate r is obtained from the position of rack *7*.

3327	GEAR-CAM SPATIAL MECHANISM FOR REPRESENTING A FUNCTION OF TWO INDEPENDENT VARIABLES	GrC MO



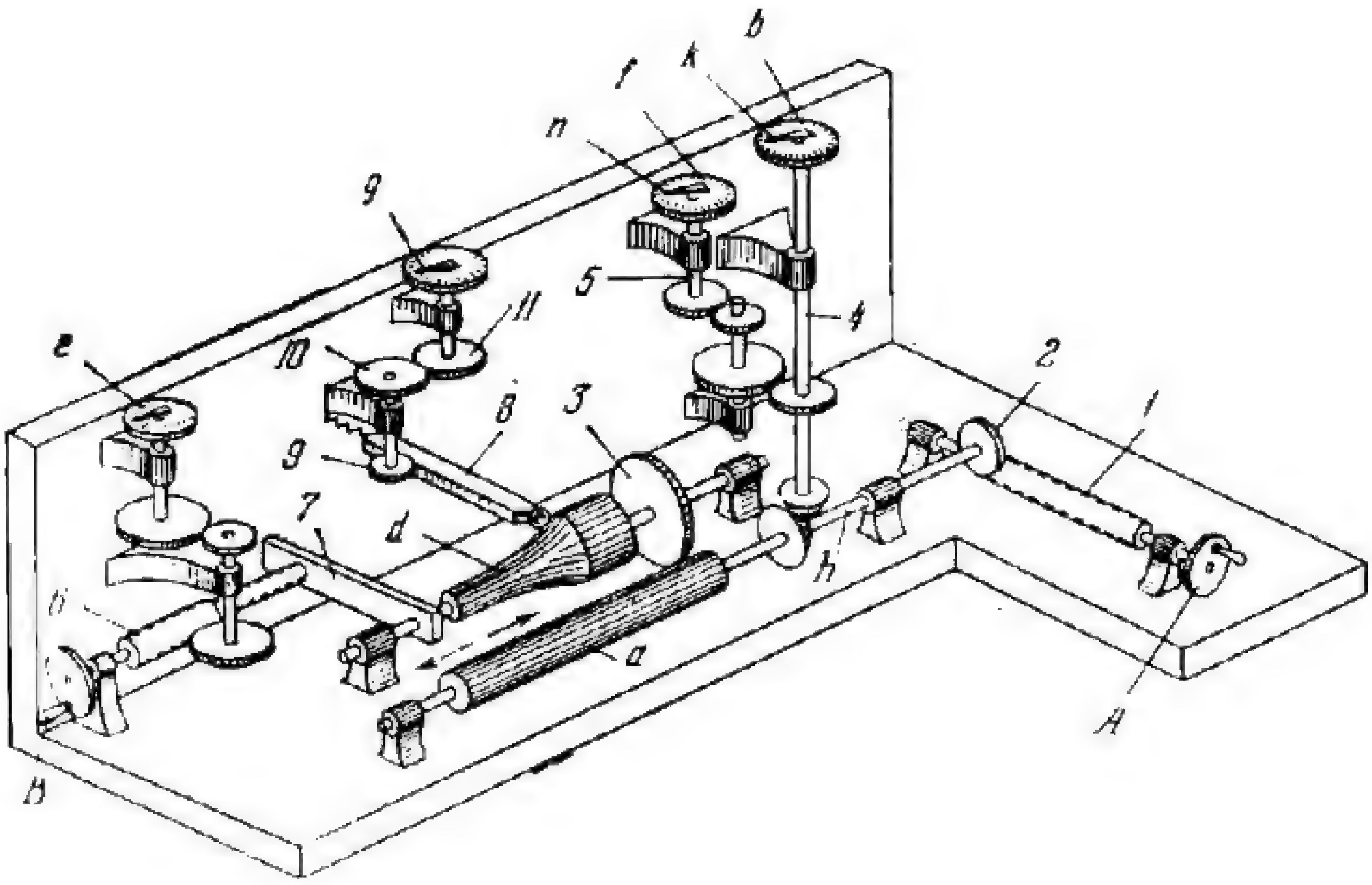
The mechanism serves to represent rectilinear translational motion given as a function of two independent variables. The position of driven link 7 is a function of the position of driving cam 2:

$$z = f(x_A, \alpha)$$

where x_A is the coordinate of point A of contact of follower 3 with cam 2, and α is the angle of rotation of cam 2. Follower 3 has simultaneous translational motions up or down and right or left. Screw 5 is rotated according to the law of variation of x_A. Follower 3 has a gear rack which rotates gear 6 an amount proportional to z, and gear 6 traverses rack 7. Rack 7 travels in fixed guides according to the equation

$$z = f(x_A, \alpha).$$

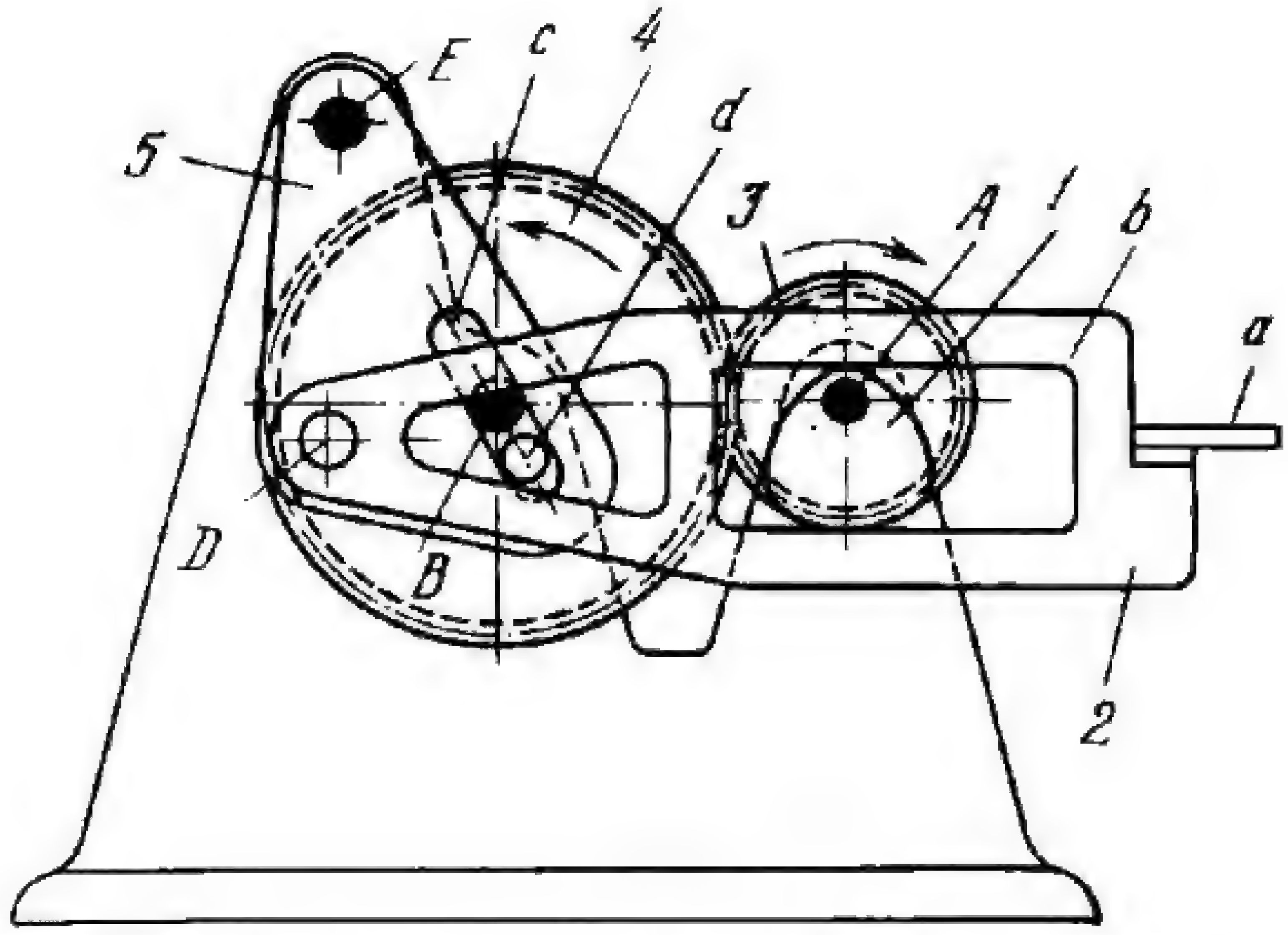
3328	GEAR-CAM SPATIAL MECHANISM FOR GENERATING A FUNCTION OF TWO VARIABLES	GrC MO



The mechanism generates the relation $z = f(\alpha, x)$. A quantity proportional to variable α is entered by turning handwheel A. From worm 1 rotation is transmitted to worm wheel 2 which is keyed to shaft h together with long gear a. Gear a transmits rotation through gear 3 to conoid d. The amount of rotation of conoid d is read off on rough and fine reading scales b and f. Hands k and n of these scales are driven from shaft h through shafts 4 and 5. A quantity proportional to variable x is entered by turning handwheel B. Axial traverse of conoid d is obtained by the rotation of worm 6 and the translational motion of nut 7 which is connected by a turning pair to the conoid. The translational motion of the conoid is registered on scale e. Conoid d transmits motion to follower 8 whose rack rotates gears 9, 10 and 11. The rotation of gear 11 is registered by hand g which indicates the value of $z = f(\alpha, x)$.

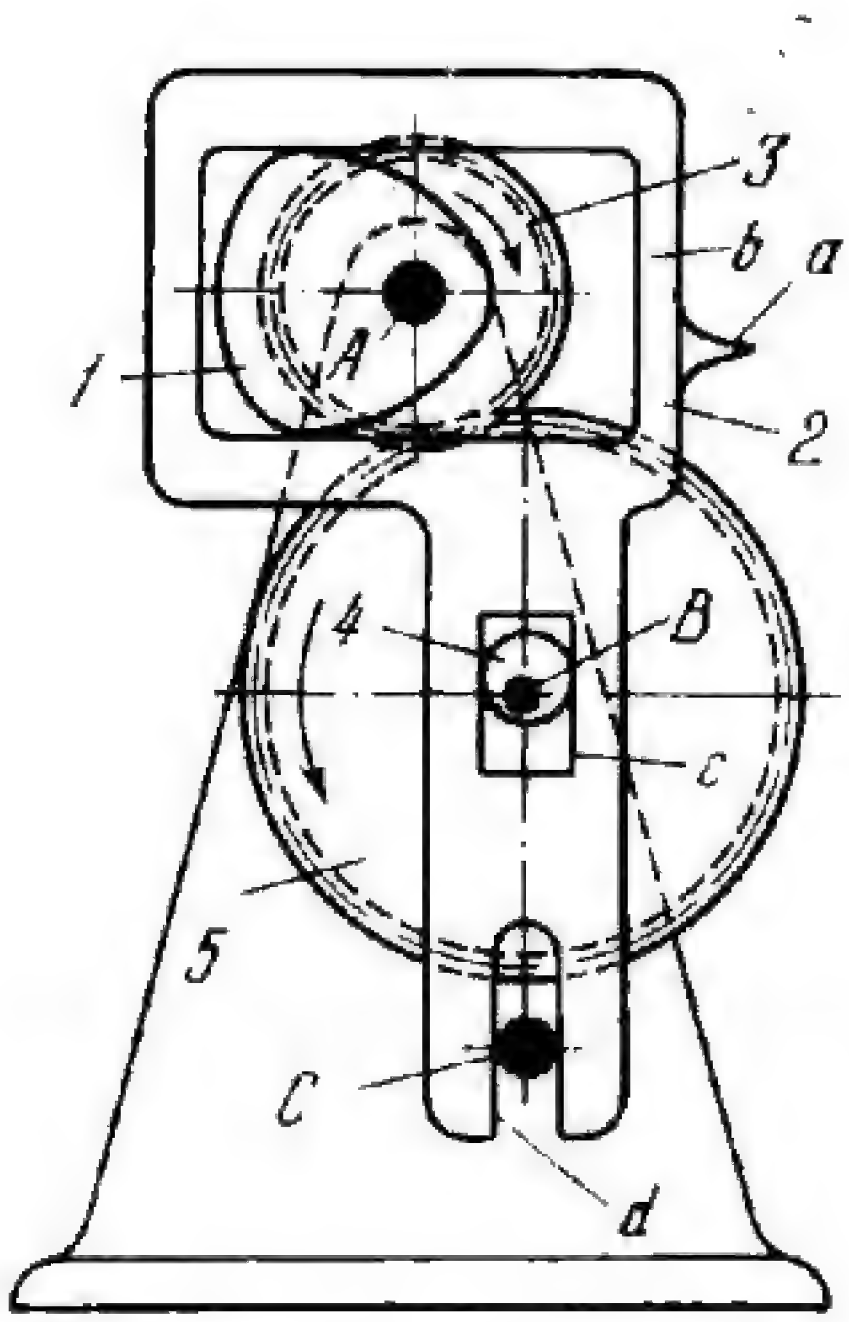
5. OPERATING CLAW MECHANISMS OF MOTION PICTURE CAMERAS (3329 through 3332)

3329	GEAR-CAM OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH A SUSPENDED YOKE	GrC OC



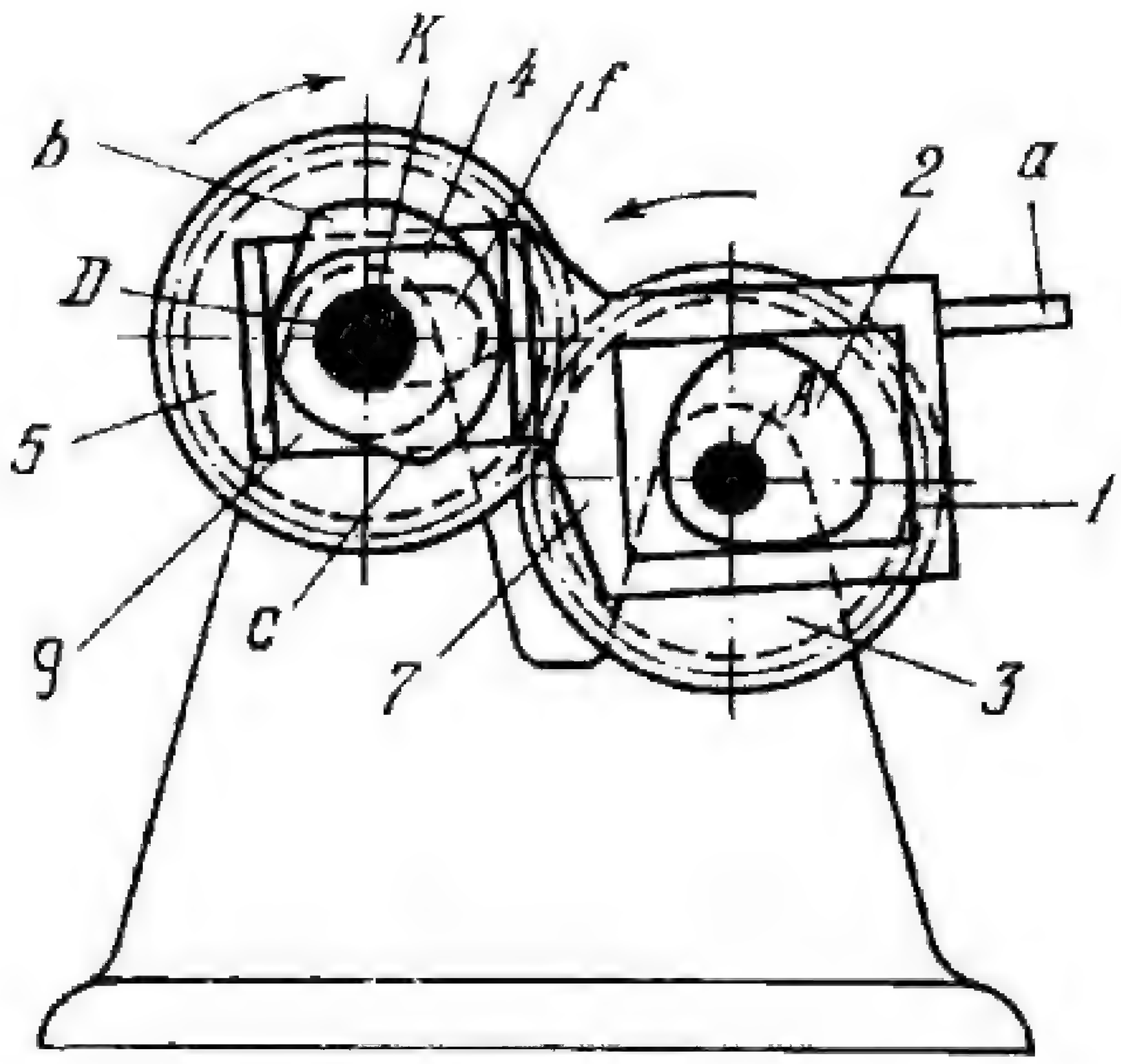
Constant-breadth cam *1* rotates about fixed axis *A* and is rigidly attached to gear *3* which meshes with gear *4*, rotating about fixed axis *B*. Cam *1* is confined between the flat faces of yoke *b* of link *2* which carries claw *a*. Link *5* turns about fixed axis *E*, is connected by turning pair *D* to link *2* and has slot *c* which slides along pin *d* of gear *4*. When cam *1* rotates, claw *a* of link *2* is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3330	GEAR-CAM OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH TWO CAMS	GrC OC



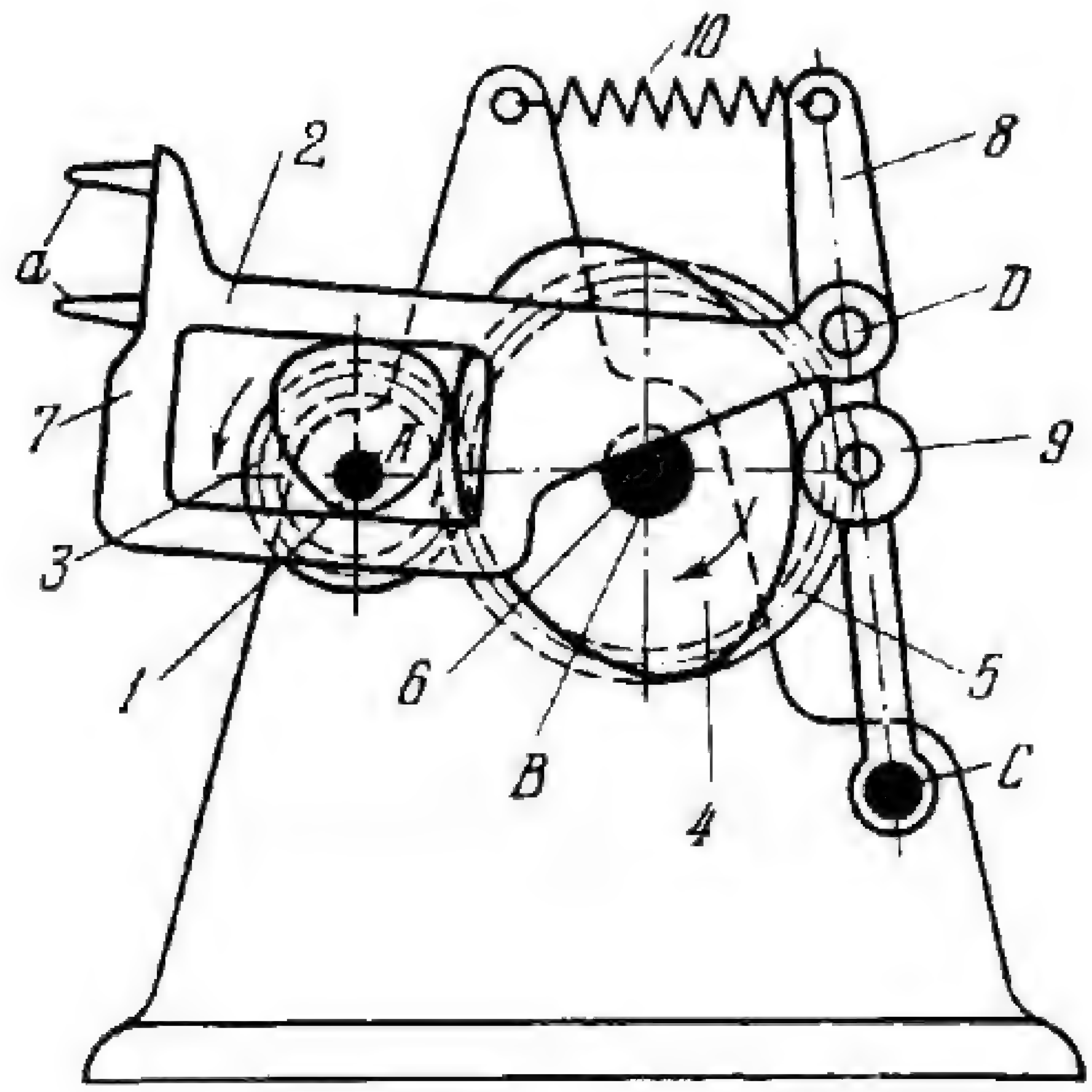
Constant-breadth cam *1* rotates about fixed axis *A* and is rigidly attached to gear *3* which meshes with gear *5*, rotating about fixed axis *B* and rigidly attached to eccentric *4*. Cam *1* is confined between the flat faces of yoke *b* of link *2* which carries claw *a*. Eccentric *4* is enclosed between the flat faces of yoke *c* of link *2* which has slot *d* sliding along fixed pin *C*. When cam *1* rotates, claw *a* of link *2* is inserted into a perforation of the film, advances the film and is withdrawn from the perforation.

3331	GEAR-CAM ADJUSTABLE OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA	GrC OC



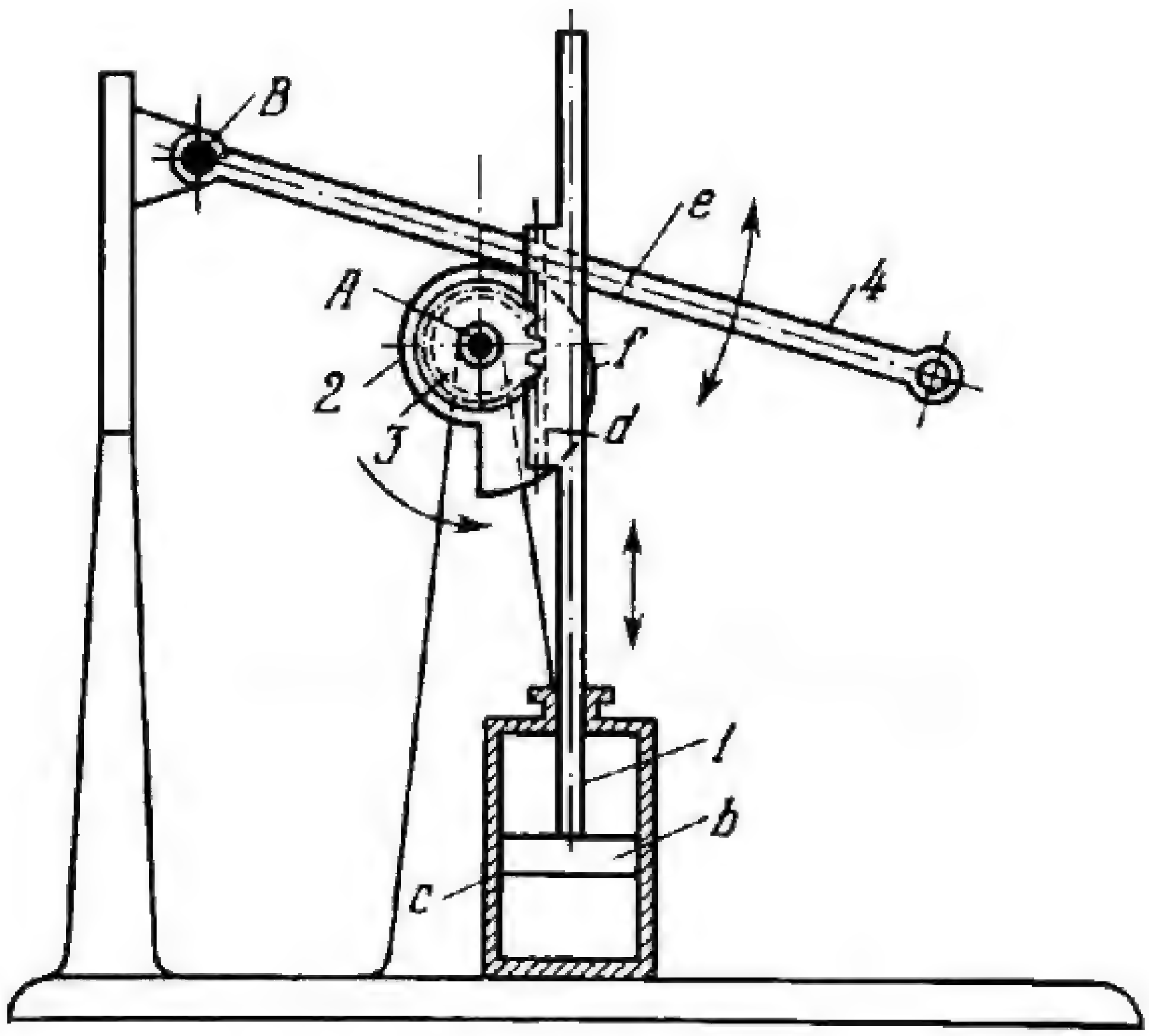
Constant-breadth cam *2* rotates about fixed axis *A* and is rigidly attached to gear *3* which meshes with gear *5*, rotating about fixed axis *D* and rigidly attached to constant-breadth cam *4*. Cam *2* is confined between the flat faces of yoke *1* of link *7* which carries claw *a*. Cam *4* is confined between the flat faces of slot *g* of link *7* which has slot *f* sliding along fixed pin *K*. When cam *2* rotates, claw *a* of link *7* is inserted into a perforation of the film, advances the film and is withdrawn from the perforation. Cam *4* is made up of two segments, *b* and *c*, which can be turned with respect to each other about axis *D* and clamped. This regulates the times in the cycle when the claw is inserted into and withdrawn from the perforation.

3332	GEAR-CAM OPERATING CLAW MECHANISM OF A MOTION PICTURE CAMERA WITH TWO CAMS	GrC OC



Constant-breadth cam *1* rotates about fixed axis *A* and is rigidly attached to gear *3* which meshes with gear *5*, rotating about fixed axis *B* and rigidly attached to plate cam *4*. Cam *1* is confined between the flat faces of yoke *2* of link *7* which is connected by turning pair *D* to follower *8*. Follower *8* turns about fixed axis *C* and carries roller *9* which rolls along the contour of cam *4*. Link *7* carries claws *a*. When cam *1* rotates, claws *a* are inserted into perforations of the film. advance the film and are withdrawn from the perforations.

3333	GEAR-CAM RACK-TYPE PISTON MACHINE MECHANISM	GrC PM



Rigidly attached to rod *1* of driving piston *b*, reciprocating in cylinder *c*, is rack *d* which meshes with pinion *3*. Pinion *3* rotates about fixed axis *A* and is rigidly attached to plate cam *2* whose contour *f* slides along surface *e* of follower *4* which turns about fixed axis *B*. When piston *b* reciprocates, follower *4* oscillates about axis *B*.

3334	GEAR-CAM INDEXING MECHANISM	GrC I

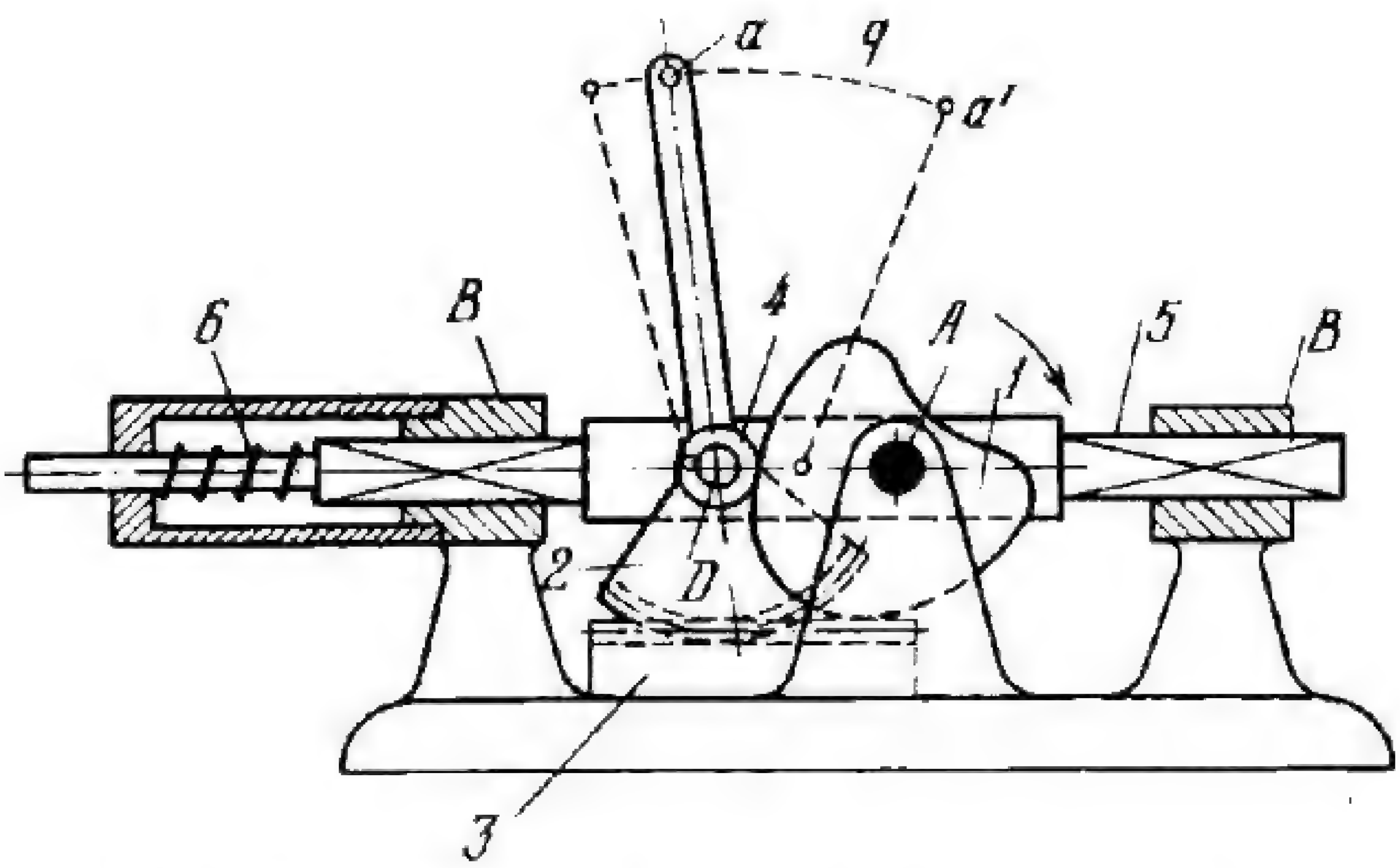


Plate cam *1* rotates about fixed axis *A*. Follower *5* reciprocates in fixed guides *B-B* and carries roller *4* which rolls along the contour of cam *1*. Follower *5* is connected by turning pair *D* to segment gear *2* which meshes with fixed rack *3*. When cam *1* rotates, segment gear *2* rolls along rack *3* and its point *a* travels along path *q* which is a portion of a prolate cycloid. In the extreme position, when point *a* reaches point *a'*, the mechanism becomes locked and segment gear *2* is indexed in this position. The mechanism is brought out of the indexed position by pushing follower *5* to the left and compressing spring *6*.

3335	GEAR-CAM MECHANISM WITH ADJUSTABLE ANGLE OF DRIVEN GEAR OSCILLATION	GrC LL

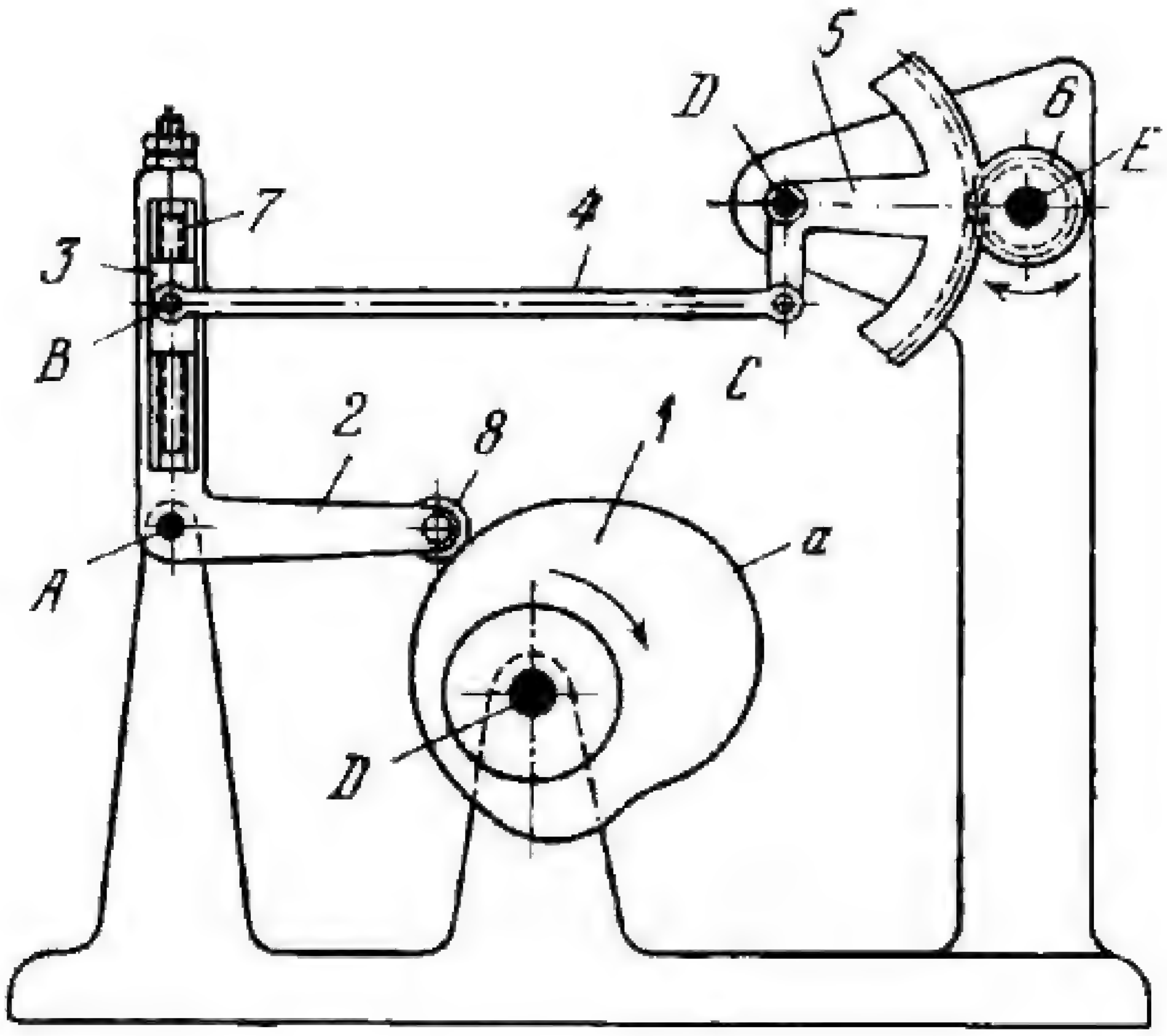
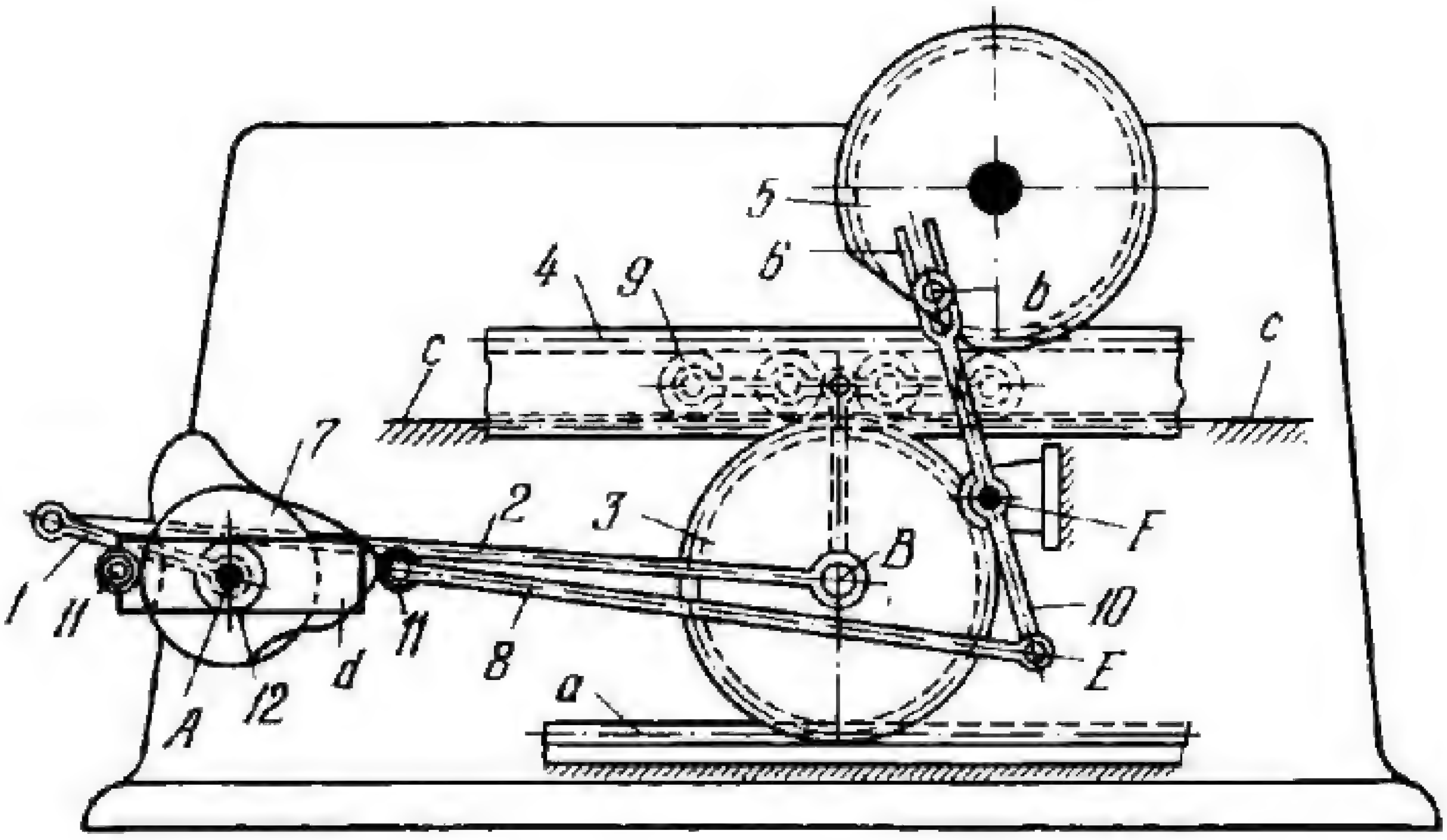


Plate cam *1* rotates about fixed axis D. Follower *2* turns about fixed axis A and carries roller *8* which rolls along contour a of cam *1*. Follower *2* has screw *7* with a nut by means of which slider *3* can be adjusted to various positions along screw *7*. This varies distance $\overline{AB}$ on follower *2*. Connecting rod *4* is connected by turning pairs B and C to follower *2* and to segment gear *5* which turns about fixed axis D and meshes with gear *6*. Gear *6* oscillates about fixed axis E and its angle of oscillation can be adjusted by means of screw *7*.

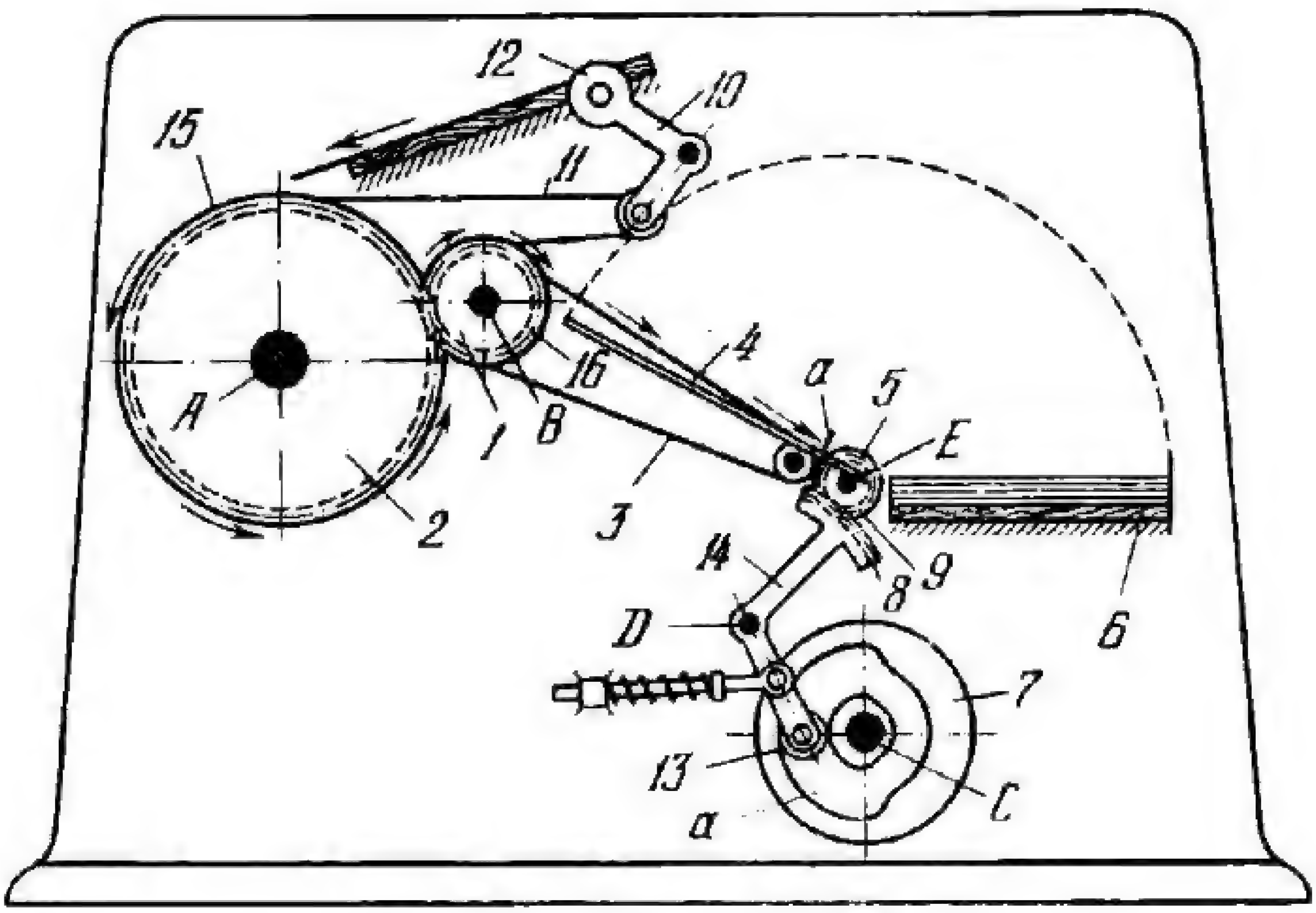
9. MECHANISMS OF OTHER FUNCTIONAL DEVICES
(3336 through 3340)

3336	GEAR-CAM DRIVE MECHANISM OF AN IMPRESSION CYLINDER	GrC FD



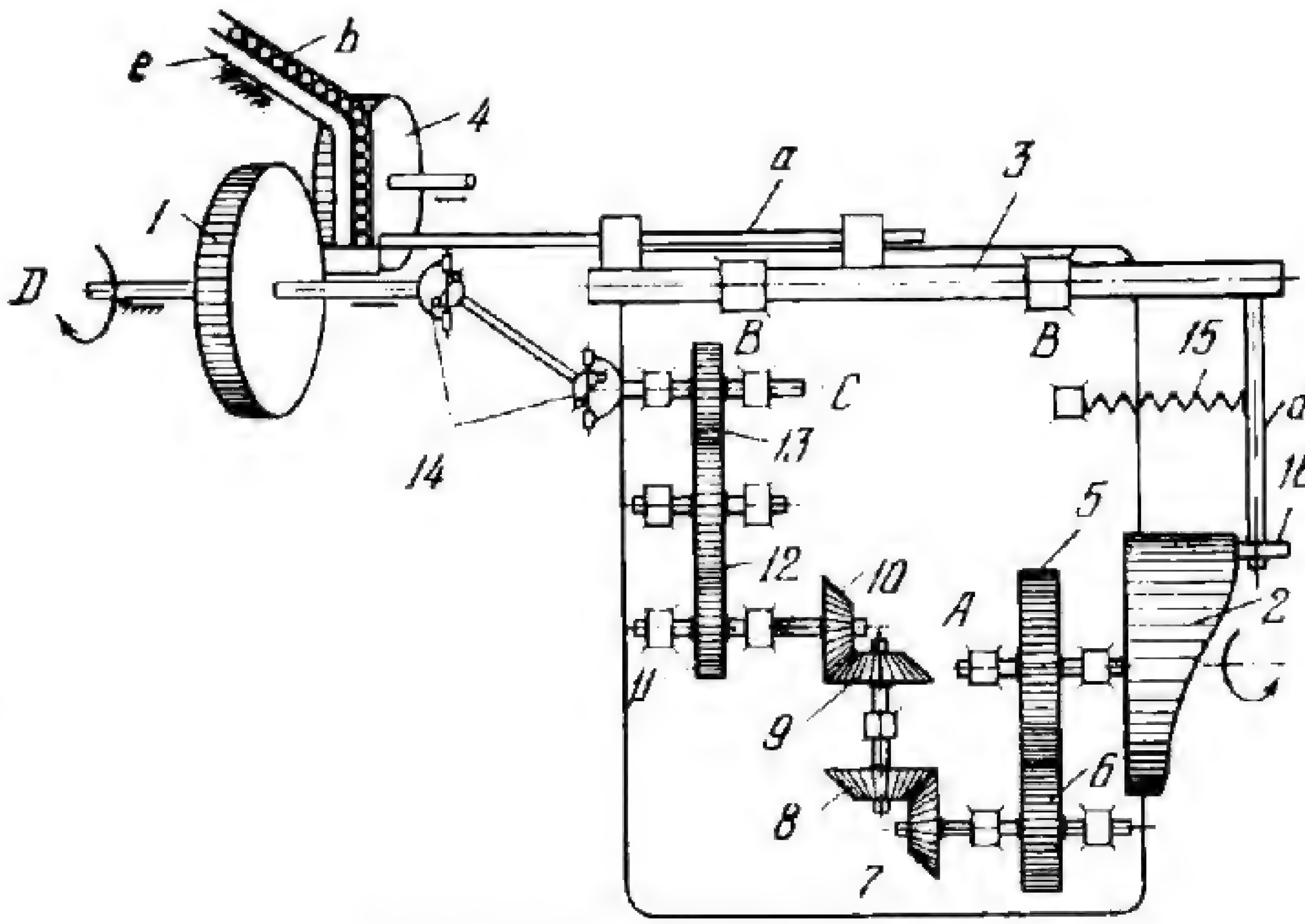
Crank *1* rotates about fixed axis *A* and transmits motion to gear *3* through connecting rod *2* which is connected by turning pair *B* to the gear. Gear *3* meshes with and rolls along fixed rack *a* which is secured to the foundation of the printing press. Gear *3* also meshes with the lower rack of type bed *4* which reciprocates with its rollers *9* along fixed guides *c-c*. A rack at the top of bed *4* meshes during the working stroke with the gear teeth of impression cylinder *5*. Cylinder *5* is stationary during the idle return stroke of bed *4* and has a flat which faces downward at this time to allow the bed to pass freely under the cylinder. The cylinder is stopped and brought into engagement with the bed by fork *6* of link *10* which is actuated by main-and-return cams *7*, keyed to the main shaft of the press. Fork *6* and link *10* turn about fixed axis *F* and are connected by turning pair *E* to link *8* which carries rollers *11*. Slot *d* of link *8* slides along roller *12* which rotates about axis *A*. Rollers *11* roll along the two contours of main-and-return cams *7*. Fork *6* catches pin *b* of cylinder *5*, turns the cylinder to its extreme position, stops and holds it during the idle stroke of the type bed.

3337	GEAR-CAM SHEET DELIVERY MECHANISM	GrC PD



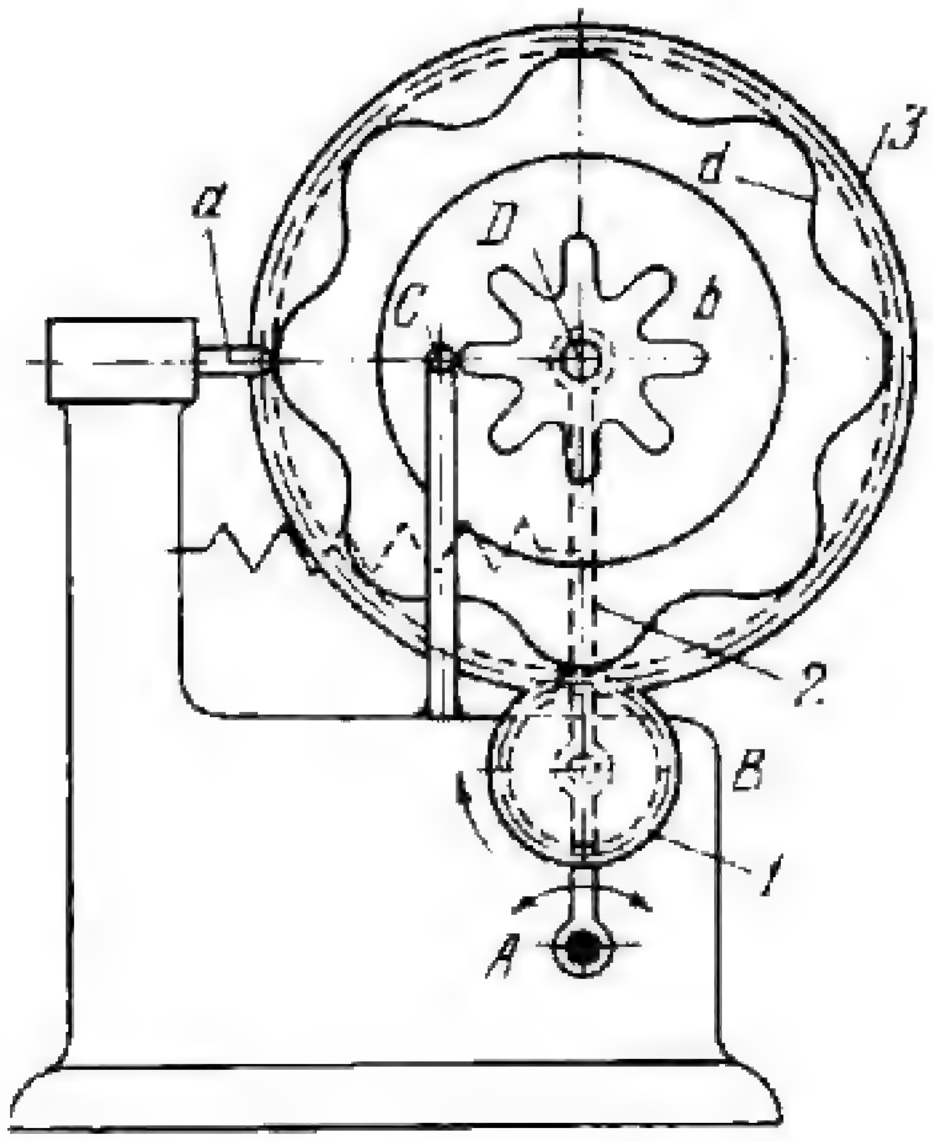
Gear *2* rotates about fixed axis *A* and meshes with gear *1* which rotates about fixed axis *B*. Face cam *7* rotates about fixed axis *C* and has profiled groove *a*. Follower *14* turns about fixed axis *D* and carries roller *13* which rolls and slides along groove *a*. Follower *14* has segment gear *8* which meshes with pinion *9*, rotating about fixed axis *E*. Conveying bands *11* run over impression cylinder *15*, rigidly attached to gear *2*, and over roll *16*, rigidly attached to gear *1*. The mechanism is intended for delivering the printed sheets. When a sheet has been printed and its leading edge reaches wooden delivery roll *16*, the grips open and the sheet is transferred from cylinder *15* to roll *16*, over which conveying strings *3* run. Strings *3* carry the sheet onto fingers *4*. Fingers *4* are mounted on shaft *5* which is rigidly attached to gear *9*. As soon as a sheet reaches stops *a* on fingers *4*, the fingers turn over the sheet and place it on delivery table *6*. The motion of fingers *4* is controlled by cam *7* which is keyed to the main shaft of the press. Link *10* with weight *12* serves to maintain the tension of bands *11*.

3338	GEAR-CAM SPATIAL BLANK FEEDING MECHANISM	GrC FD



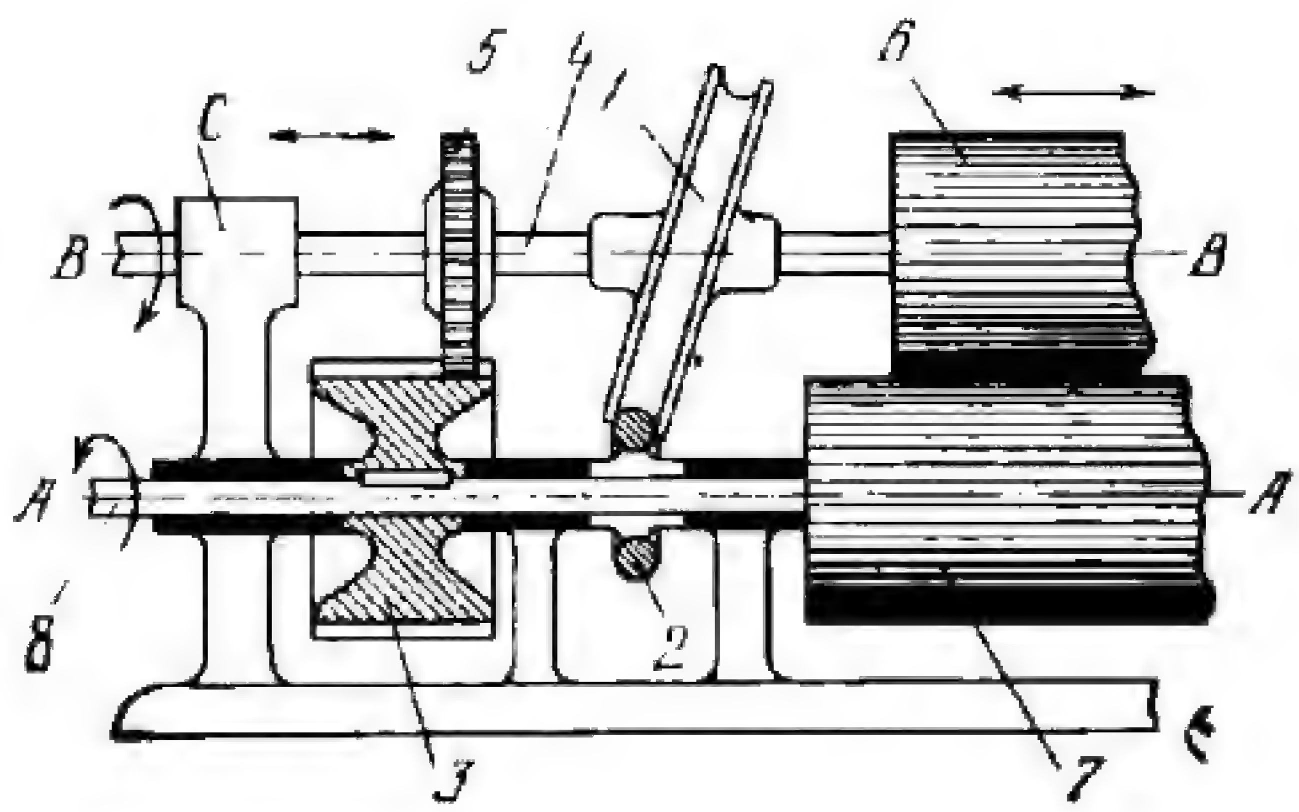
End cam *2* rotates about fixed axis *A*. Follower *3* reciprocates in fixed guides *B-B* and has rigidly attached rod *d* carrying roller *16* which rolls along the working surface of cam *2*. Rigidly attached to follower *3* is pusher *a*. Grinding wheel *1* rotates about fixed axis *D* and is driven by an electric motor (not shown). Motion is transmitted from wheel *1* through double-universal joint *14* to shaft *C* and further through spur gears *13*, *12* and *11*, bevel gears *10*, *9*, *8*, and *7*, and spur gears *6* and *5* to cam *2*. Blanks *b* move in a continuous line along chute *e* of the feeder. In each revolution of cam *2*, pusher *a* advances one blank *b* between grinding wheel *1* and regulating wheel *4*. Roller *16* is held in contact with cam *2* by spring *15*.

3339	GEAR-CAM MECHANISM OF A COPYING DEVICE	GrC FD



Driving gear *1* rotates about axis *B* of link *2* which turns about fixed axis *A*. Gear *1* meshes with gear *3* which rotates about axis *D* of link *2* and is rigidly attached to template *d* and to blank *b*. When gear *1* rotates, template *d* slides along fixed pin *a* and the cutting tool (milling cutter), mounted at point *C*, machines blank *b* whose finished shape is determined by the shape of template *d*.

3340	GEAR-CAM SLANTED-WASHER DISTRIBUTOR ROLLER MECHANISM	GrC FD



Wide gear *3* and distributor roller *7* are keyed to shaft *8* and rotate about fixed axis *A-A*. Gear *3* meshes with gear *5* and roller *7* contacts roller *6* which are rigidly attached together with slanted washer *1* to shaft *4* which rotates about and reciprocates along axis *B-B* in fixed guide *C*. Washer *1* engages roller *2* of shaft *8*. When shaft *8* rotates, roller *6* rotates about and reciprocates along axis *B-B*.

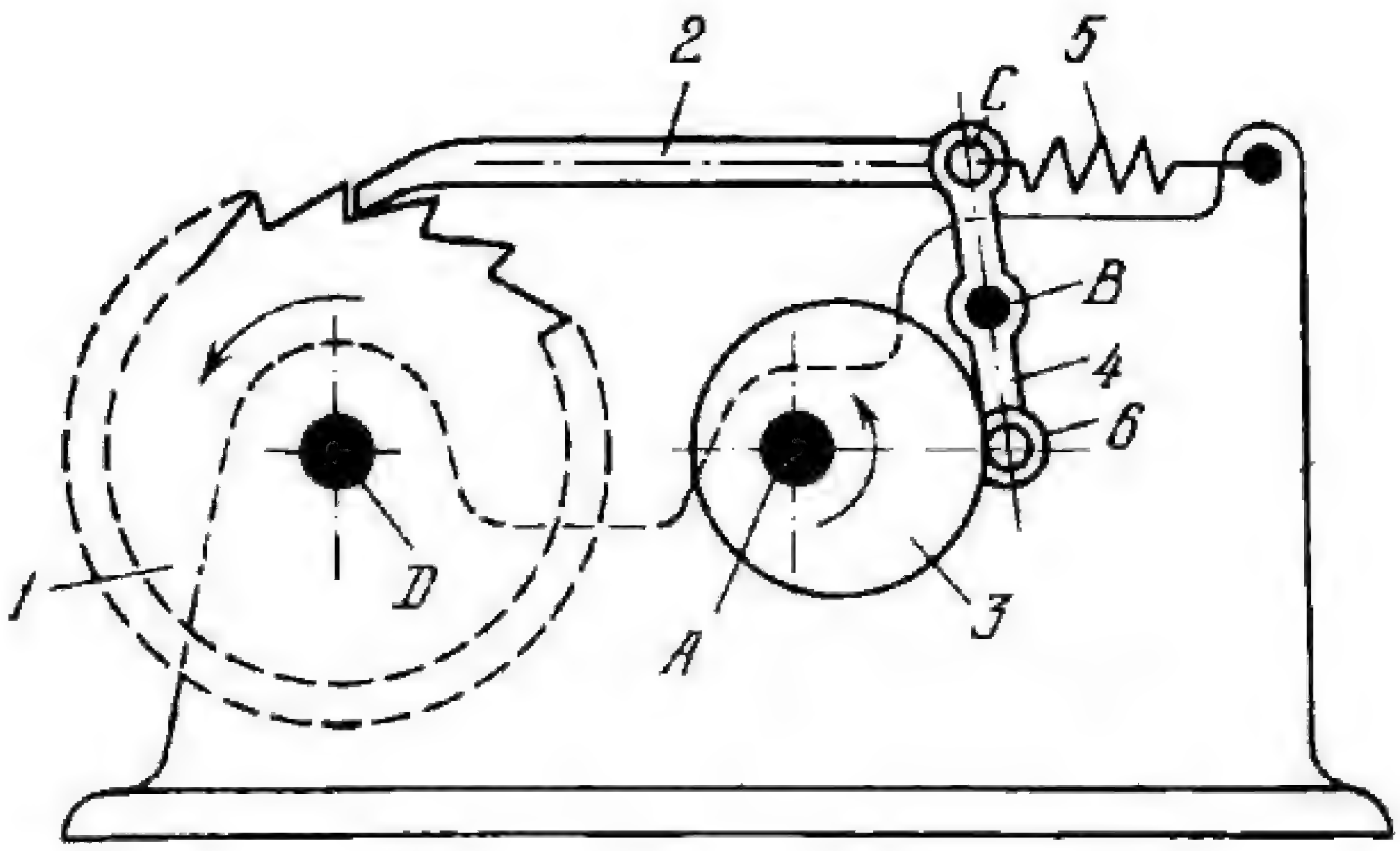
SECTION TWENTY-THREE

Cam-Ratchet Mechanisms

CR

1. General-Purpose Multiple-Link Mechanisms ML (3341 through 3347)
2. Dwell Mechanisms D (3348)
3. Switching, Engaging and Disengaging Mechanisms SE (3349)
4. Link-Length Adjustment Mechanisms LL (3350 and 3351)
5. Piston Machine Mechanisms PM (3352)
6. Sorting and Feeding Mechanisms SF (3353 and 3354)
7. Mechanisms of Other Functional Devices FD (3355 through 3359)

3341	CAM-RATCHET INTERMITTENT MOTION MECHANISM	CR ML



Round eccentric *3* rotates about fixed axis *A*. Follower *4* turns about fixed axis *B* and carries roller *6* which rolls along the contour of eccentric *3*. Pawl *2* turns about axis *C* of link *4* and engages the teeth of ratchet wheel *1* which rotates about fixed axis *D*. To each revolution of eccentric *3*, wheel *1* turns through the angle $\varphi = 2\pi/z$, where z is the number of teeth on wheel *1*. Roller *6* is held in contact with eccentric *3* by spring *5*.

3342	DOUBLE-CAM-RATCHET INTERMITTENT MOTION MECHANISM	CR ML

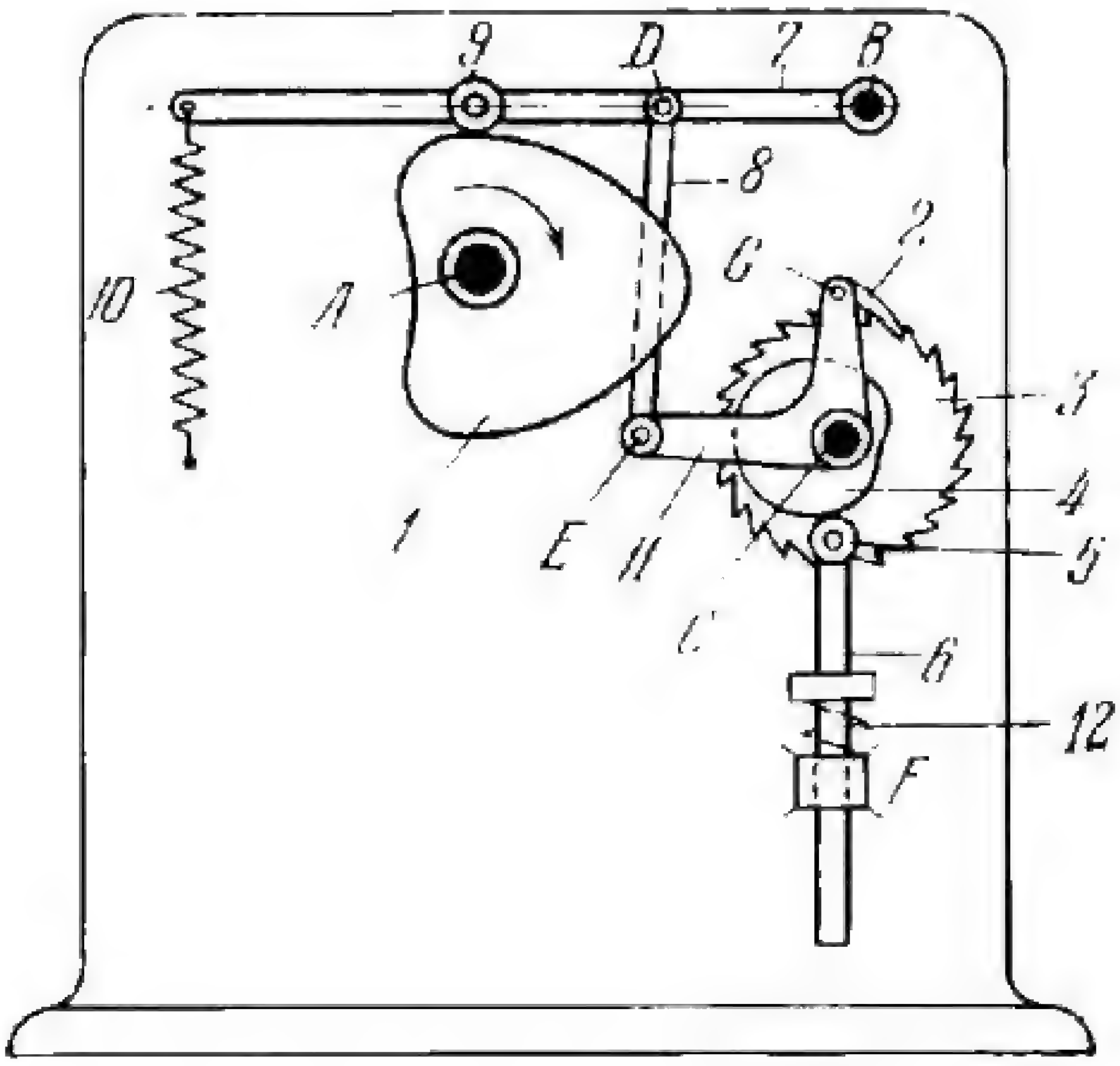
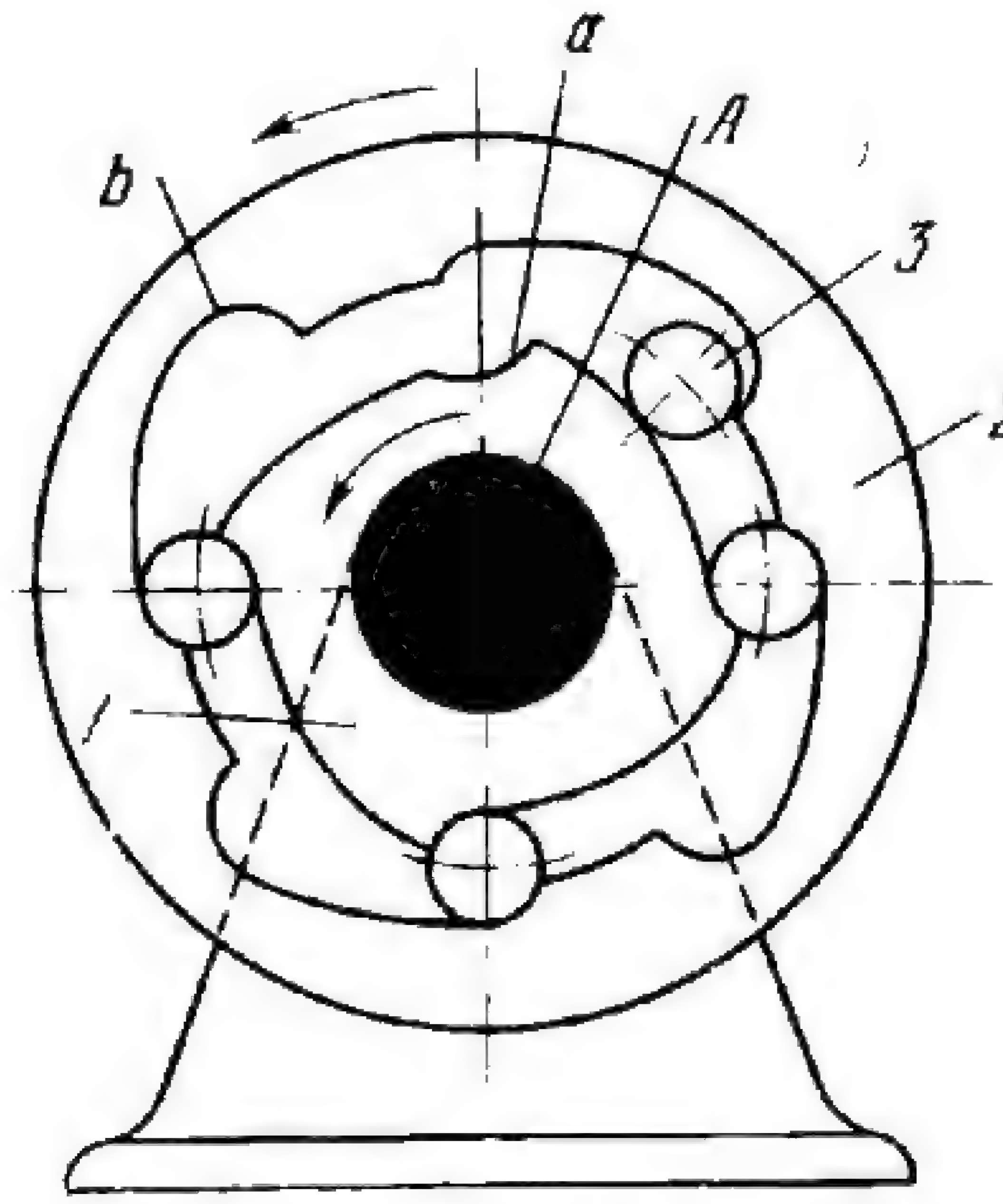


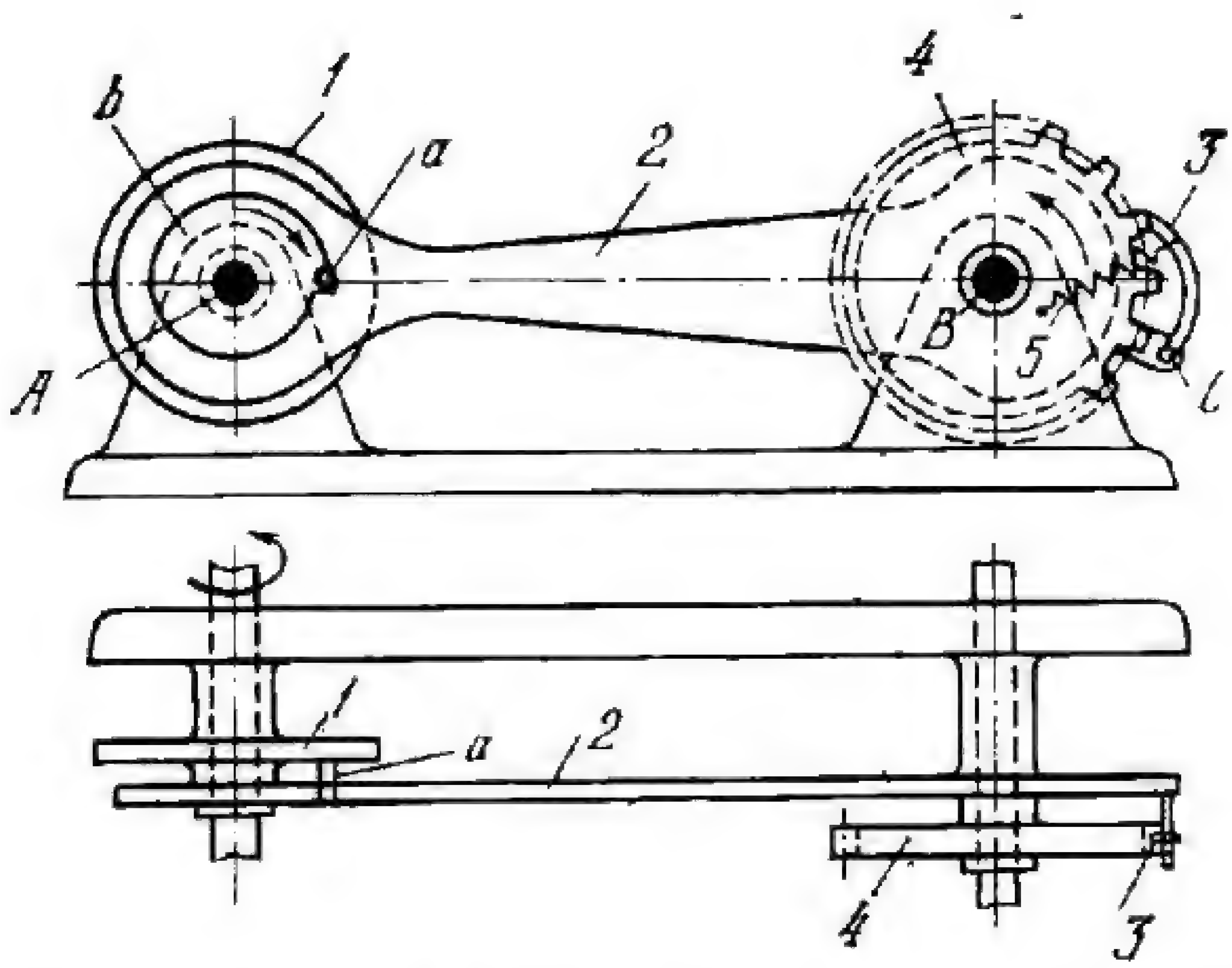
Plate cam *1* rotates about fixed axis *A*. Follower *7* turns about fixed axis *B* and carries roller *9* which rolls along the contour of cam *1*. Link *8* is connected by turning pairs *D* and *E* to follower *7* and to lever *11* which turns about fixed axis *C*. Pawl *2* turns about axis *G* of lever *11* and engages the teeth of ratchet wheel *3* which rotates freely about axis *C*. Plate cam *4* is rigidly attached to wheel *3*. Follower *6* reciprocates in fixed guide *F* and carries roller *5* which rolls along the contour of cam *4*. When cam *1* rotates continuously, follower *6* has a complex intermittent motion which depends on the shapes of cams *1* and *4*, and the dimensions of the other links. Rollers *9* and *5* are held in contact with cams *1* and *4* by springs *10* and *12*.

3343	CAM-RATCHET MECHANISM WITH BALL-TYPE PAWLS	CR ML



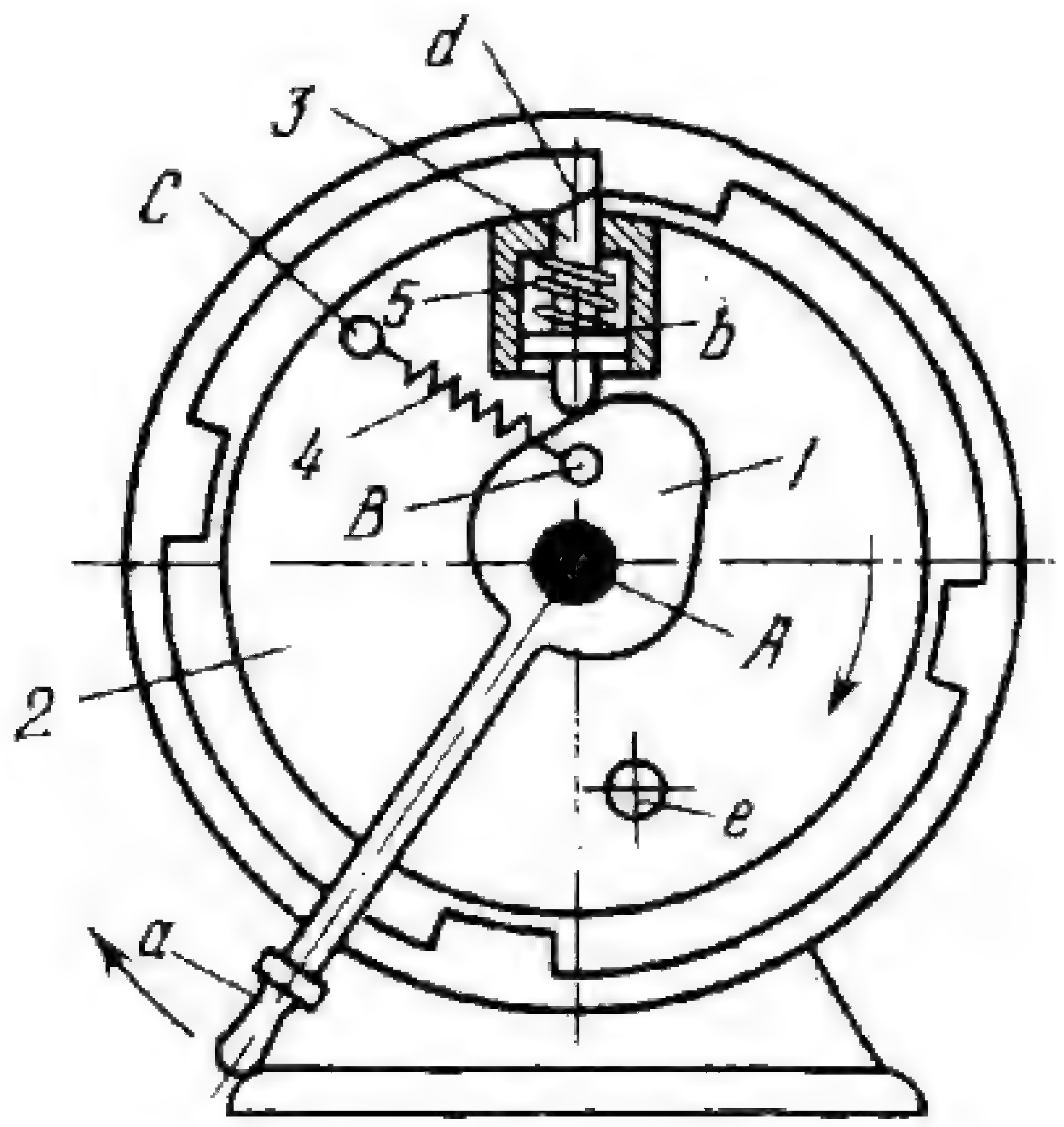
Power is transmitted from the driving to the driven link by balls *3* which are gripped between cam *1* and ratchet wheel *2*. Either cam *1* or wheel *2* may serve as the driving member. Cam *1* rotates about fixed axis *A* and has circular recesses *a*. Wheel *2* rotates freely about axis *A* and has circular recesses *b*. The balls roll by gravity between the surfaces of cam *1* and wheel *2*. The driving member oscillates and the driven member rotates intermittently in one direction.

3344	INTERNAL-CAM-RATCHET INTERMITTENT DRIVE MECHANISM	CR ML



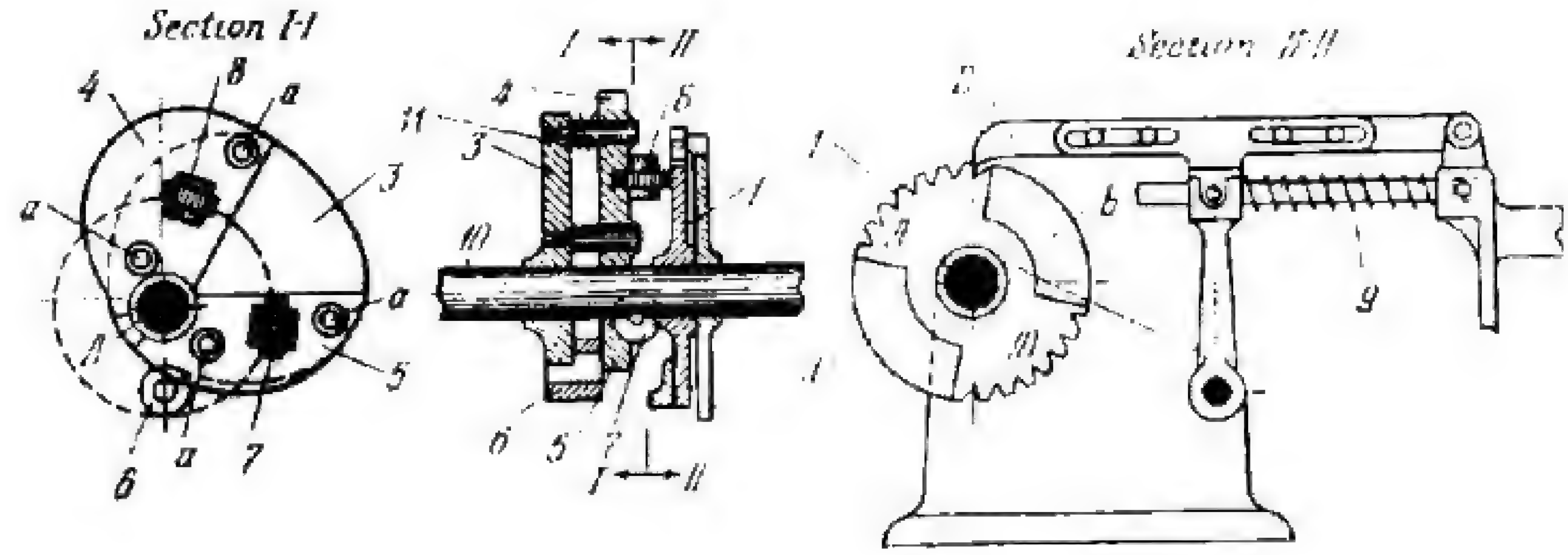
Disk *1* rotates clockwise about fixed axis *A*. Lever *2* oscillates about fixed axis *B* and has internal cam surface *b* along which pin *a* of disk *1* slides. Lever *2* has a lug with axis *C* about which pawl *3* turns. Pawl *3* engages the teeth of ratchet wheel *4* which rotates freely about axis *B*. When disk *1* rotates, its pin *a* engages the shoulder in cam surface *b*, turning lever *2* counterclockwise until a point is reached where pin *a* passes over the shoulder. Thus lever *2* oscillates and pawl *3* turns ratchet wheel *4* intermittently with dwells. Pawl *3* is held in contact with wheel *4* by spring *5*.

3345	CAM-RATCHET MECHANISM WITH A SPRING-DRIVEN DISK	CR ML



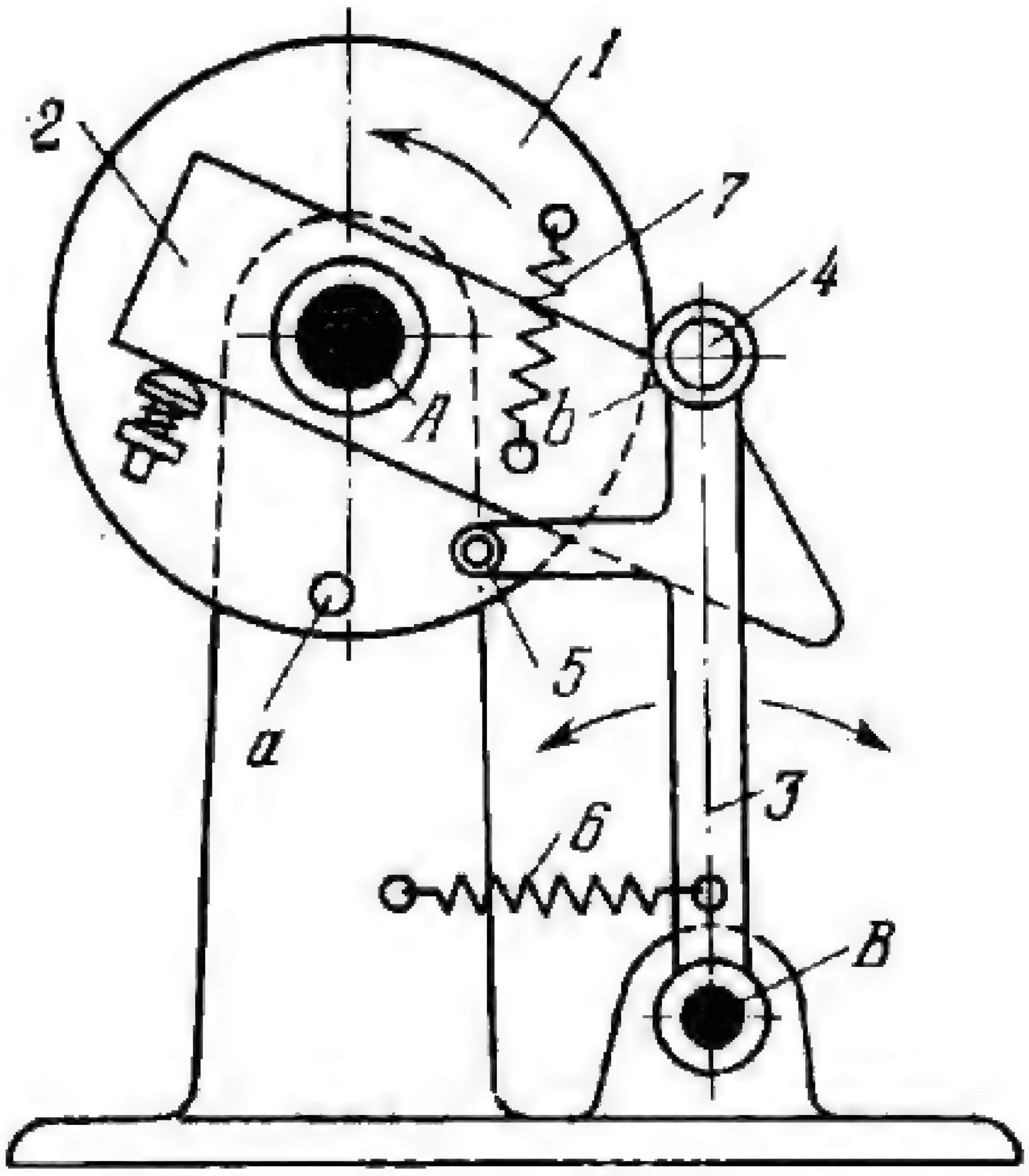
Cam *1* turns about fixed axis *A*. Disk *2* turns freely about axis *A* and has guide *b* for latch *3* which is held by spring *5* in contact with cam *1*. Spring *4* is fastened at points *C* and *B* to disk *2* and cam *1*. When handle *a* of cam *1* is turned clockwise, spring *4* is stretched, latch *3* is forced toward the centre out of engagement with lug *d* of the fixed housing and disk *2* is turned by spring *4* clockwise about axis *A* until latch *3* engages the next lug. Pin *e* in disk *2* is used to return the disk to its initial position.

3346	CAM-RATCHET MECHANISM WITH AUTOMATICALLY CHANGED CAM PROFILE	CR ML



While the pressure on a certain part of the machine is within a definite limit, disk *1* with ratchet teeth rotates together with shaft *10* about fixed axis *A*. Keyed to shaft *10* is main cam *3* which acts on follower roller *6*. Main cam *3* carries two auxiliary cams *4* and *5* which are connected to cam *3* by pins *a* and can slide axially along these pins. Cam *4* carries roller *8* and cam *5*, roller *7*. Rollers *7* and *8* are held by springs *11* against disk *1* which has two side cams *d* and *b*. When the allowable pressure on the part is exceeded, spring *9* is compressed and pawl *2* drops into engagement with a ratchet tooth. This stops disk *1* and cams *d* and *b* come into engagement with rollers *7* and *8*, forcing cams *4* and *5* along pins *a* to the left. Now these cams engage the wide follower roller *6*, thereby changing the rise, dwell and drop.

3347	CAM-RATCHET MECHANISM WITH AN OSCILLATING FOLLOWER	CR ML



The mechanism is intended for rapid return of the follower to the initial position. Disk *1* rotates counterclockwise about fixed axis *A* and is connected by spring *7* to cam *2* which turns freely about axis *A*. Follower *3* turns about fixed axis *B* and carries rollers *4* and *5*. In the position shown, roller *4* enters recess *b* in cam *2* to lock follower *3*. When disk *1* rotates, cam *2* and follower *3* remain stationary until pin *a* of disk *1* contacts roller *5*, turning follower *3* and releasing cam *2*. Follower *3* is swung farther to the right by the action of cam *2* on roller *4*. If disk *1* is stopped in any position, follower *3* is rapidly returned to its initial position by spring *6*.

3348	CAM-RATCHET VARIABLE-DWELL MECHANISM	CR D

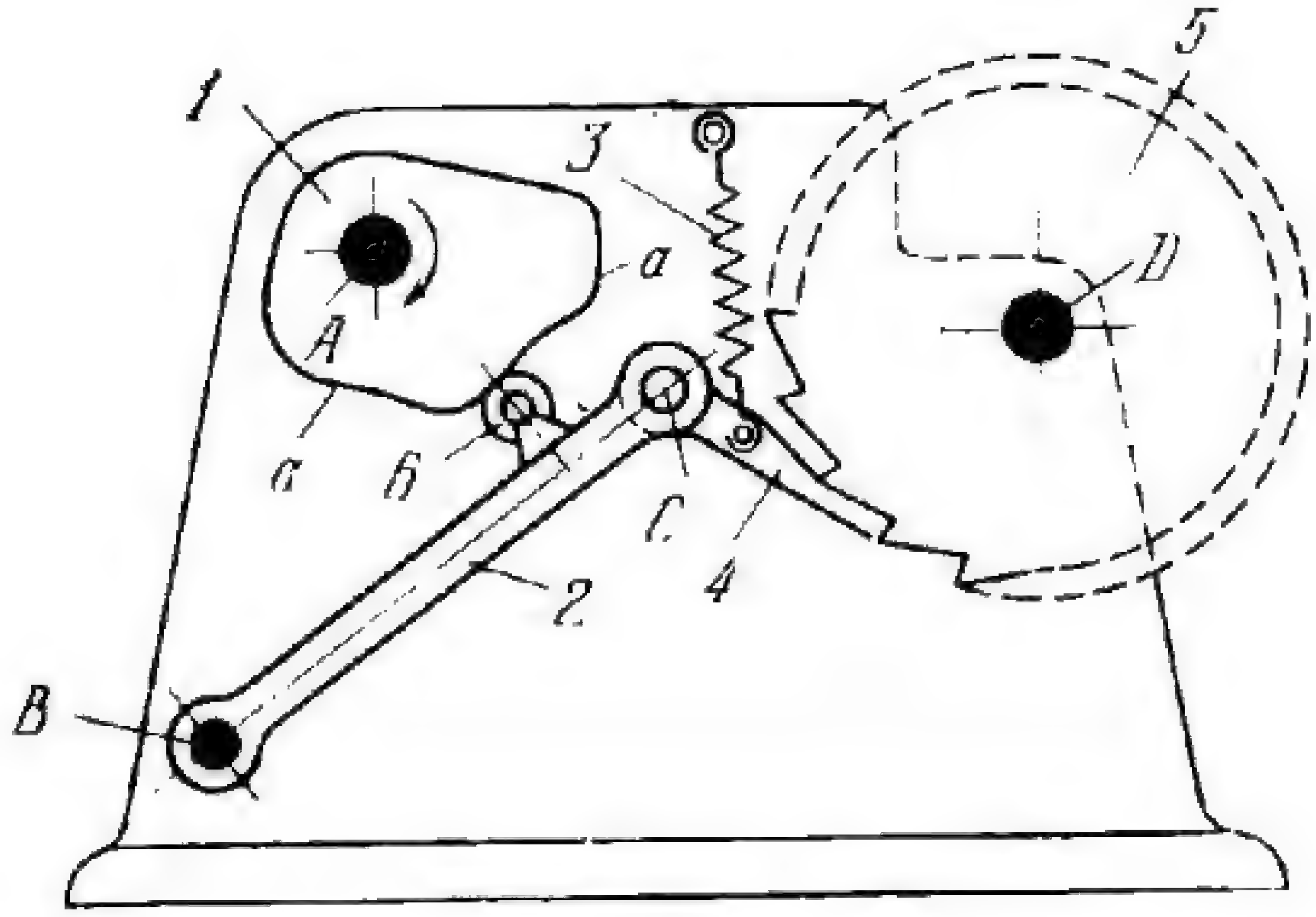
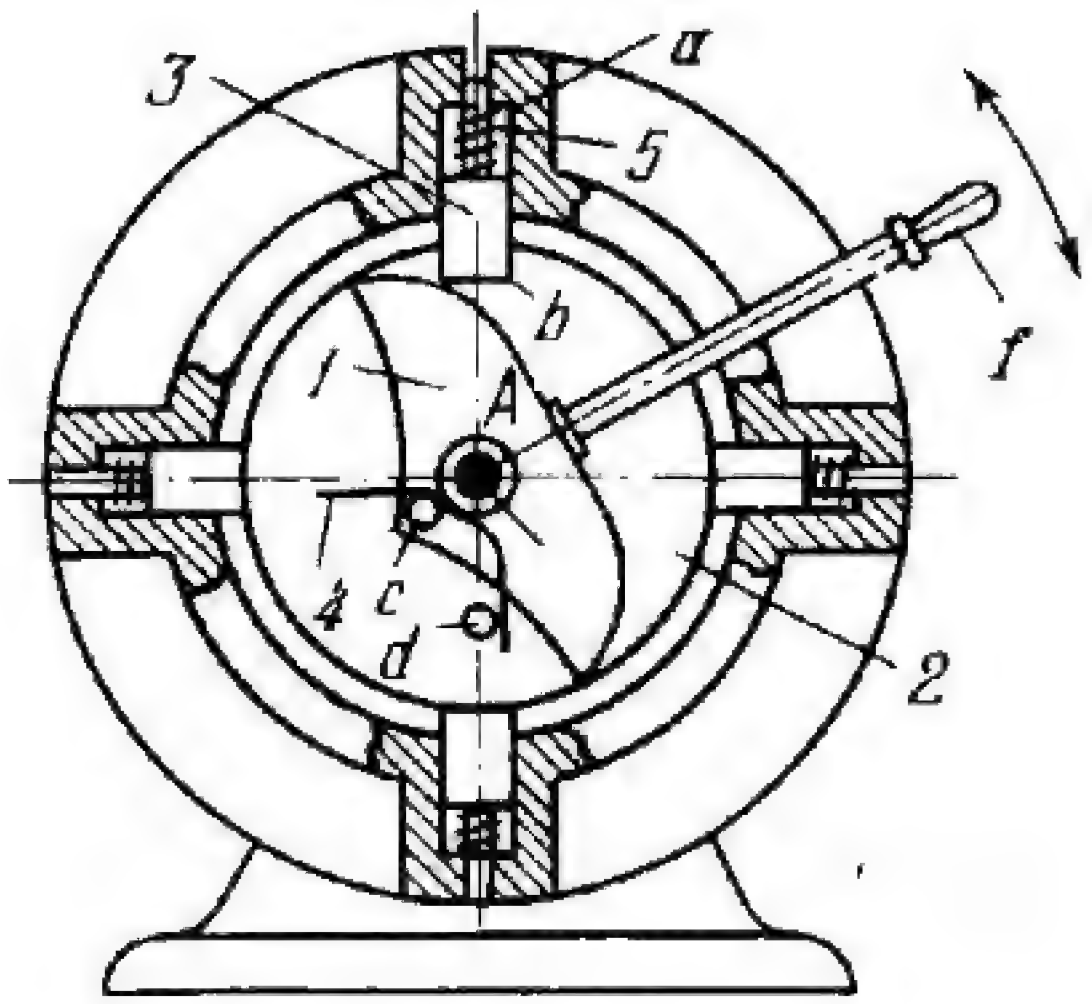


Plate cam *1* rotates about fixed axis *A*. Follower *2* turns about fixed axis *B* and carries roller *6* which rolls along the contour—complex curve *a-a*—of cam *1*. Pawl *4* turns about axis *C* of follower *2* and engages the teeth of ratchet wheel *5* which rotates about fixed axis *D*. When cam *1* rotates, ratchet wheel *5* rotates intermittently with dwells whose number and length depend upon the profile *a-a* of cam *1*. Roller *6* is held against cam *1* and pawl *4* against ratchet wheel *5* by spring *3*.

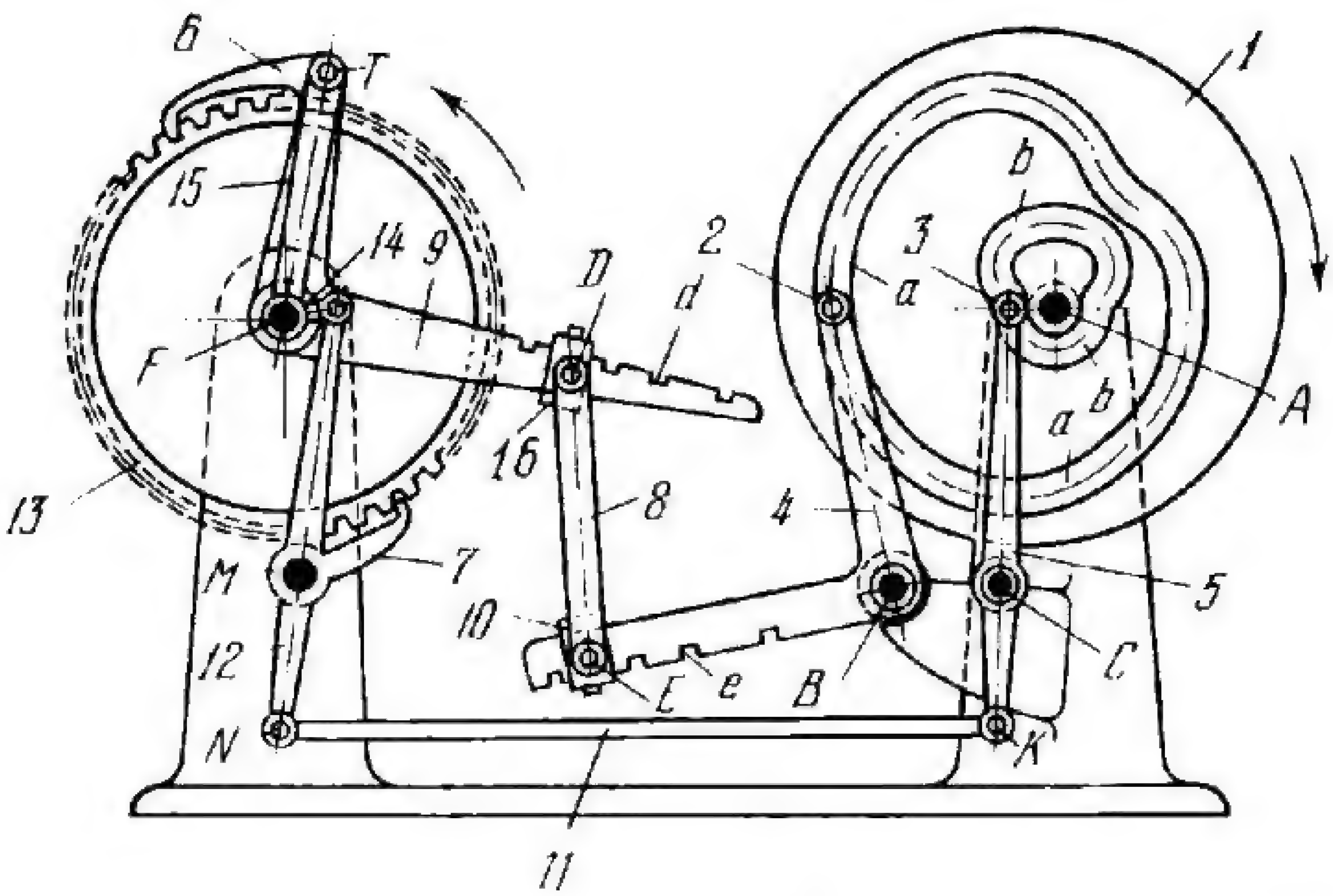
3349	CAM-RATCHET SWITCHING MECHANISM	CR SE



Cam *1* rotates about fixed axis *A*. Pawls *3* slide in fixed guides *a* of the housing and springs *5* force them inward. Disk *2* turns about axis *A* and has slot *b* into which a pawl *3* drops periodically. Torsion spring *4* encircles the axis of rotation of cam *1* and one of its ends bears against pin *c* of cam *1* and the other against pin *d* of disk *2*. When cam *1* is turned by handle *f* in either direction, it disengages pawl *3* from disk *2* which is turned by spring *4* to its next position where another pawl *3* drops into slot *b*.

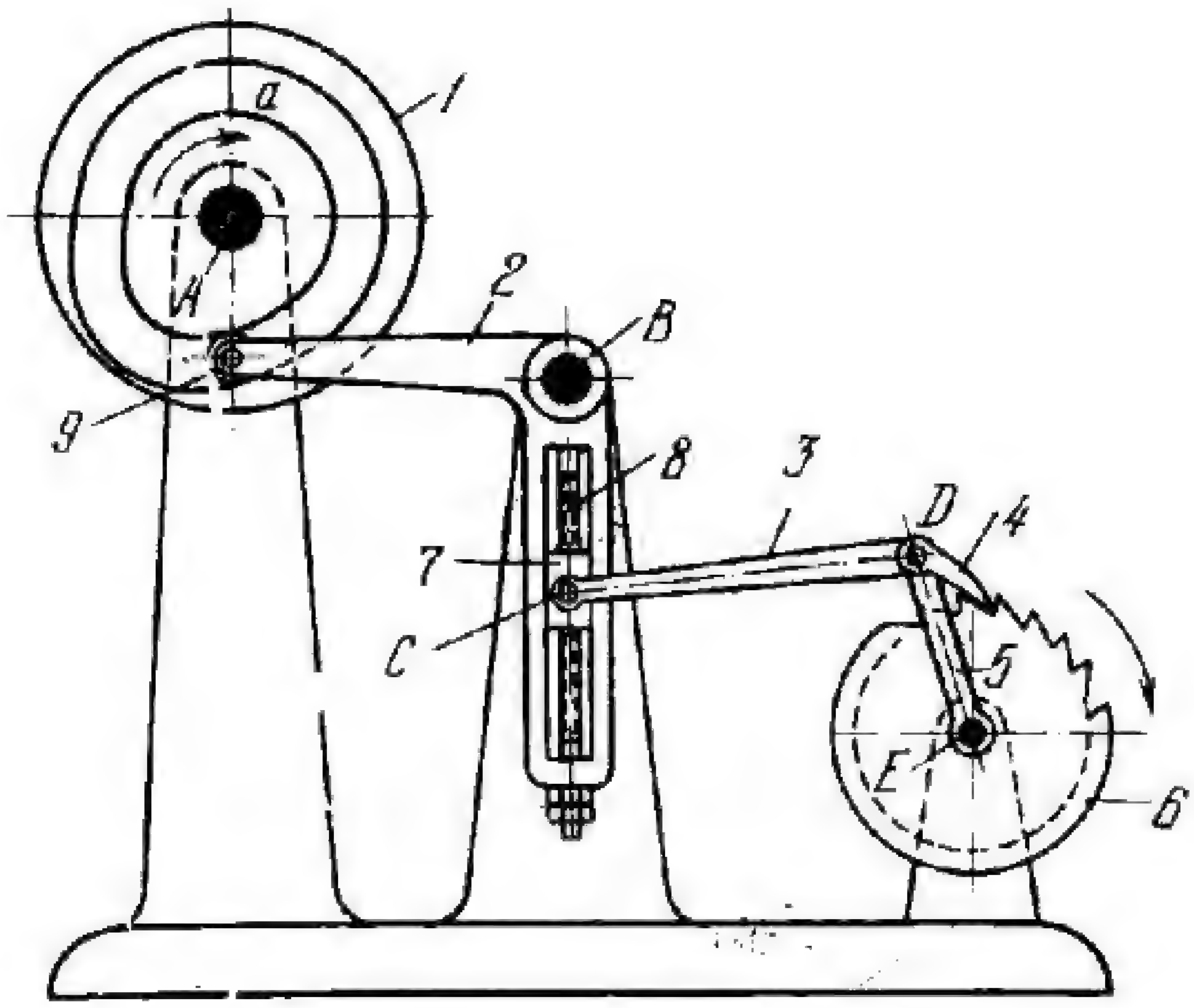
4. LINK-LENGTH ADJUSTMENT MECHANISMS (3350 and 3351)

3350	CAM-RATCHET-LEVER MECHANISM WITH VARIABLE WHEEL ROTATION	CR LL



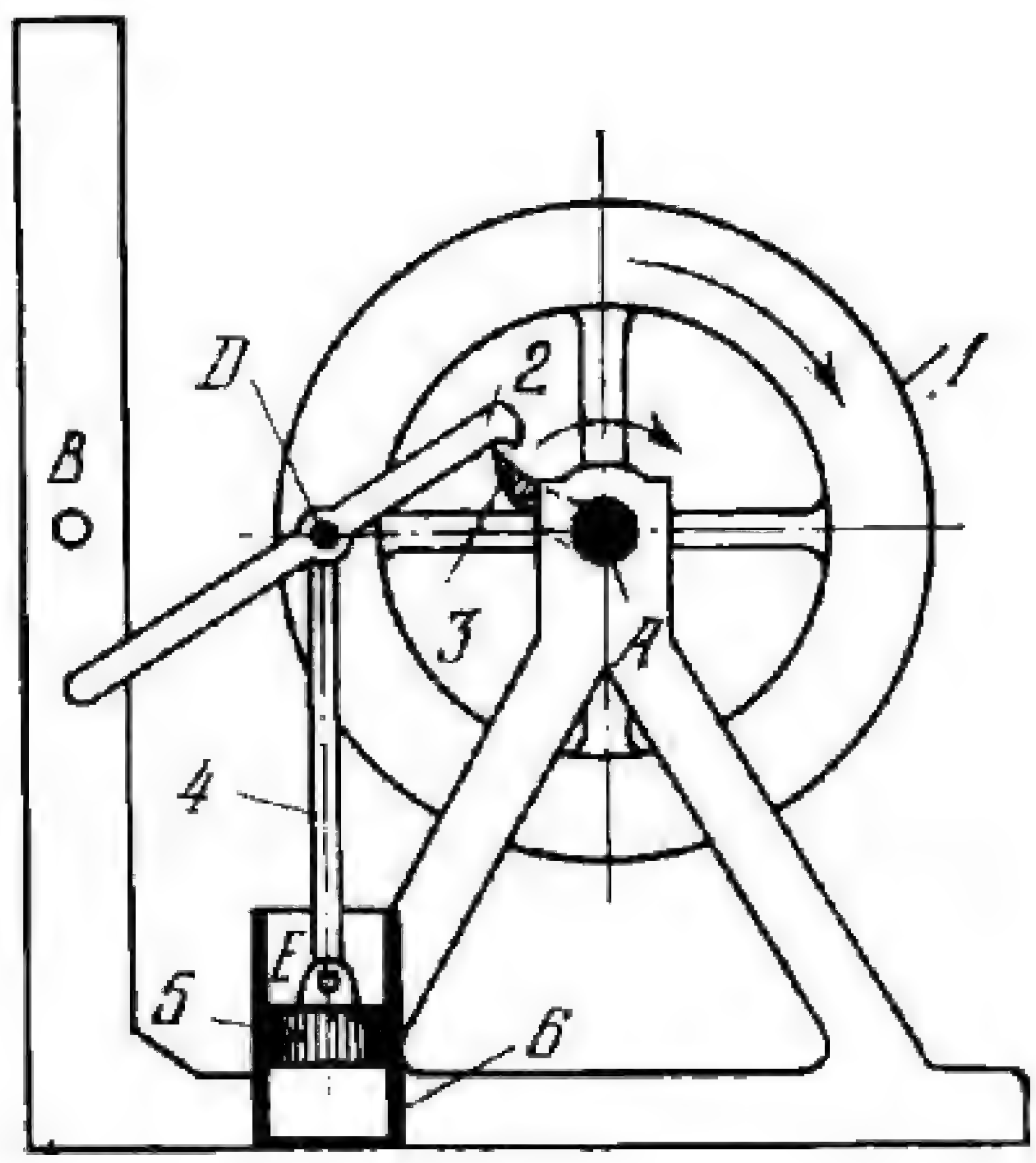
Face cam *1* rotates about fixed axis *A* and has two profiled grooves, *a* and *b*. Followers *4* and *5* turn about fixed axes *B* and *C* and carry rollers *2* and *3* which roll and slide along grooves *a* and *b*. Link *8* is connected by turning pairs *E* and *D* to follower *4* and to lever *9* which turns about fixed axis *F*. Links *4* and *9* have notches *e* and *d* for setting and clamping shackles *10* and *16*. Link *11* is connected by turning pairs *K* and *N* to follower *5* and to link *12* which turns about fixed axis *M* and carries rigidly attached pawl 7. Pawl *7* periodically engages ratchet wheel *13* which rotates freely about axis *F*. Pawl *6* turns about axis *T* and is engaged to and disengaged from wheel *13* by links *14* and *15*. When cam *1* rotates, pawl *6* rotates wheel *13* intermittently with dwells whose length can be varied by adjusting shackles *10* and *16* (at the ends of link *8*) along links *4* and *9*, and clamping them in the required positions. During the dwells, pawl *6* is raised by links *5*, *11*, *12*, *14* and *15*, and pawl *7* is engaged to wheel *13* to prevent its unintentional rotation.

3351	CAM-RATCHET-LEVER MECHANISM WITH VARIABLE WHEEL ROTATION	CR LL



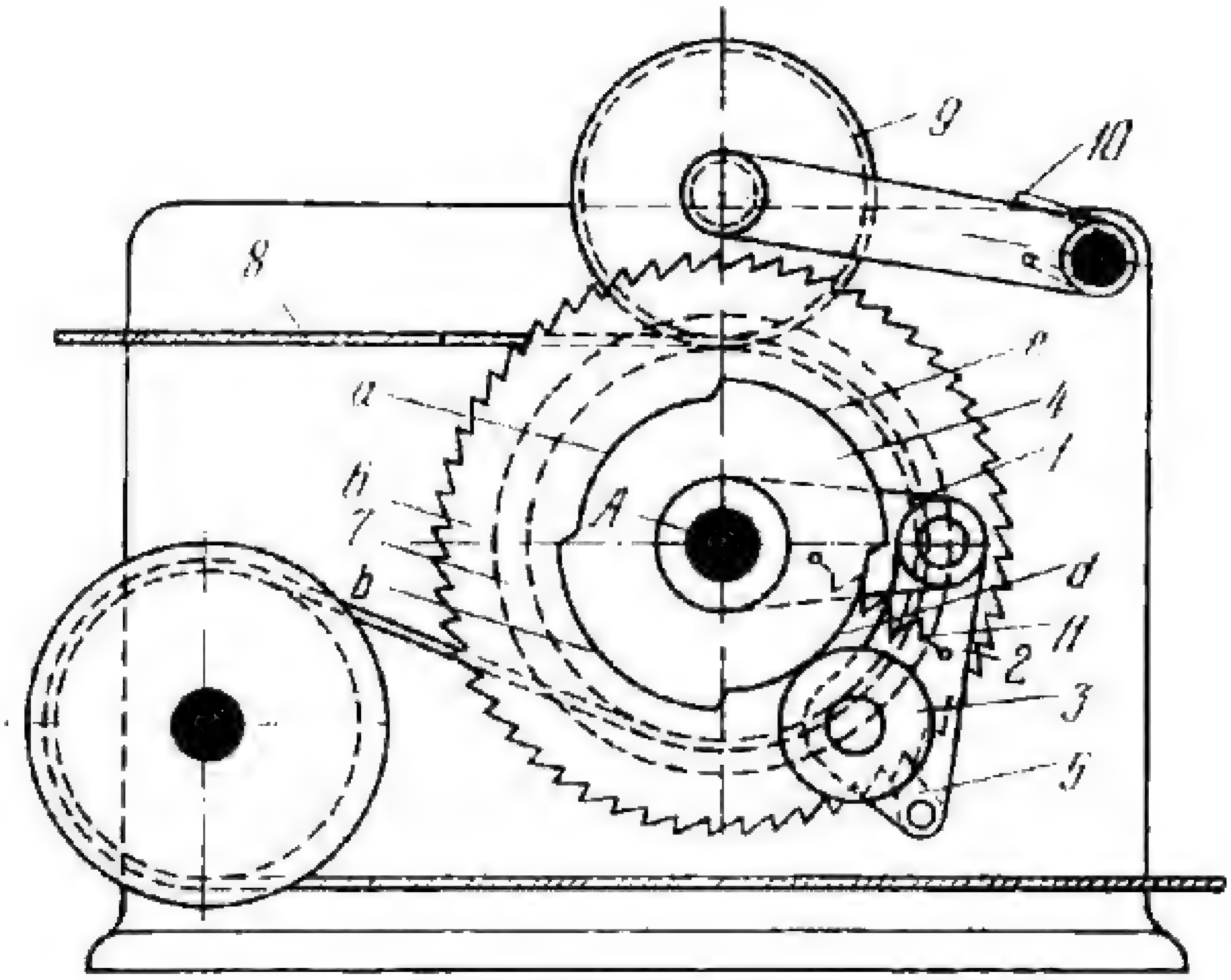
Face cam *1* rotates about fixed axis *A* and has profiled groove *a*. Follower *2* turns about fixed axis *B* and carries roller *9* which rolls and slides along groove *a*. Follower *2* has screw *8* with a nut by means of which slider *7* can be adjusted to various positions along screw *8*. This varies distance $\overline{BC}$ on follower *2*. Connecting rod *3* is connected by turning pairs *C* and *D* to slider *7* and to lever *5* which turns about fixed axis *E*. Pawl *4* turns about axis *D* and periodically engages ratchet wheel *6* which rotates about axis *E*. When cam *1* rotates continuously, ratchet wheel *6* rotates intermittently with dwells, and the angle of rotation can be varied by means of screw *8*.

3352	CAM-RATCHET PUMP MECHANISM	CR PM



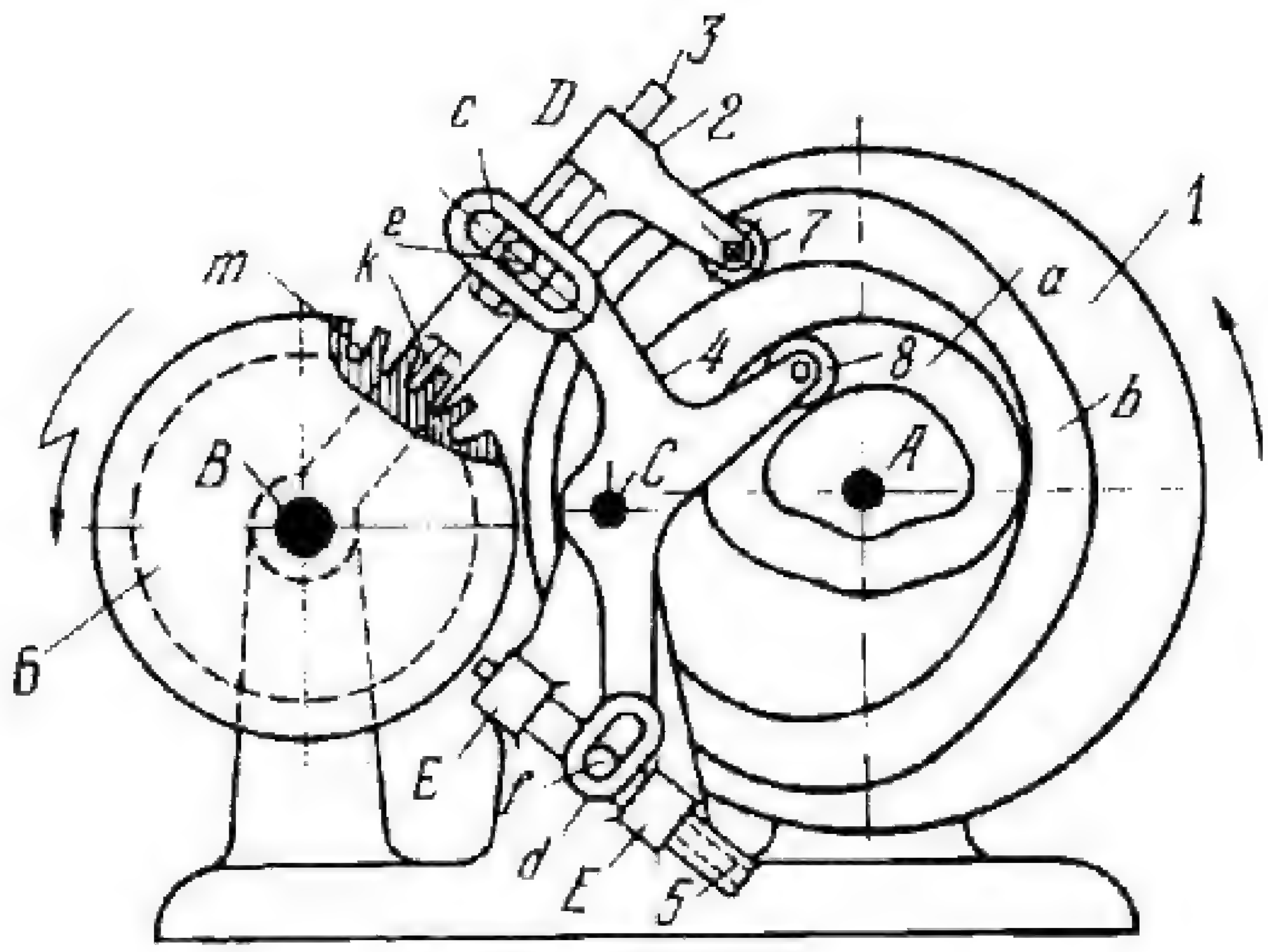
Pawl *2* is connected by turning pairs *D* to the rim of wheel *1*, freely rotating about shaft *A*, and to plunger *4* which is connected by turning pair *E* to piston *5*. Piston *5* reciprocates in fixed pump cylinder *6*. Hooked member *3* is rigidly attached to and rotates with shaft *A*. When shaft *A* rotates clockwise, member *3* engages pawl *2* and wheel *1* begins to rotate, pulling piston *5* upward until the shank of pawl *2* runs against fixed pin *B*. This disengages the pawl from member *3*, and plunger *4* together with piston *5* moves downward by gravity.

3353	CAM-RATCHET THIN-WIRE INTERMITTENT FEEDING MECHANISM	CR SF



When shaft *A* rotates, roller *3* is rolled around fixed cam *4* by means of feed crank *1* and link *2*. As roller *3* drops into low places *a* and *d* of cam *4*, pawl *5*, carried by link *2*, engages the teeth of ratchet wheel *6*. This turns feed roll *7* which is rigidly attached to ratchet wheel *6*. Roll *7* and wheel *6* rotate freely on shaft *A*. Roll *7* feeds a definite length of wire *8* to the cutting-off shear. As roller *3* engages high parts *b* and *e* of cam *4*, link *2* is pushed outward and pawl *5* is disengaged from the ratchet wheel. At this, feed roll *7* stops together with the feeding motion of the wire. Idler roll *9*, by means of spring *10*, exerts pressure on wire *8* against roll *7* required to provide the necessary traction to feed the wire. Spring *11* holds roller *3* against cam *4*.

3354	CAM-RATCHET INTERMITTENT FEEDING MECHANISM	CR SF



Cam *1* rotates about fixed axis *A* and has two profiled grooves, *a* and *b*. Follower *4* turns about fixed axis *C* and carries roller *8* which rolls and slides along groove *a*. Follower *4* has two slotted arms with slots *d* and *c*. Slot *c* slides along pin *e* of pawl *3* which slides in guide *D* of follower *2*. Follower *2* turns about fixed axis *B* and carries roller *7* which rolls and slides along groove *b*. Latch *5* slides in fixed guides *E* and carries pin *f* which slides in slot *d*. Drum *6* rotates about axis *B*. When cam *1* rotates continuously, drum *6* is rotated intermittently by tooth *k* of pawl *3* when it enters a tooth space *m* of drum *6*. At the same time, latch *5* is retracted from a tooth space *m*.

7. MECHANISMS OF OTHER FUNCTIONAL DEVICES
(3355 through 3359)

3355	CAM-RATCHET MECHANISM OF A RECORDING SYSTEM	CR FD

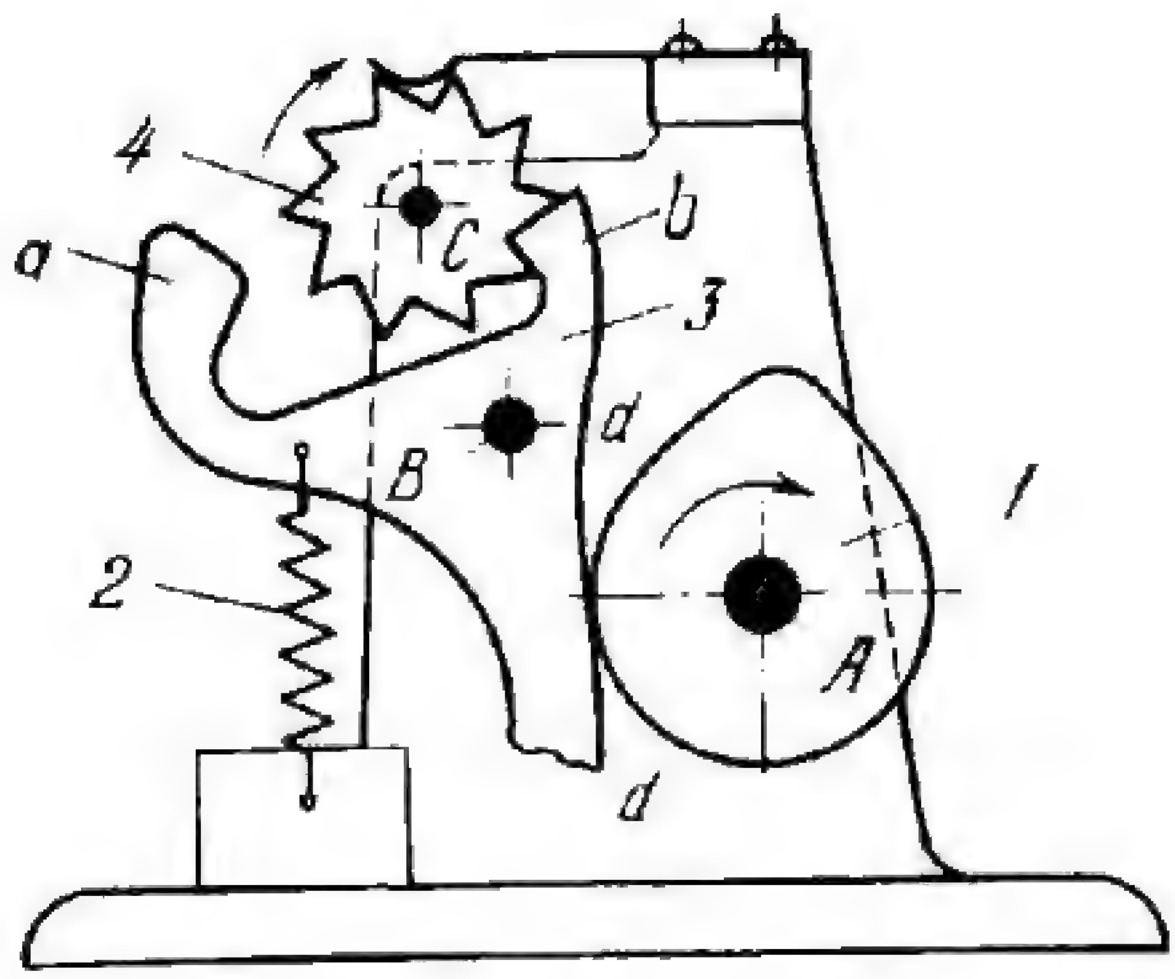
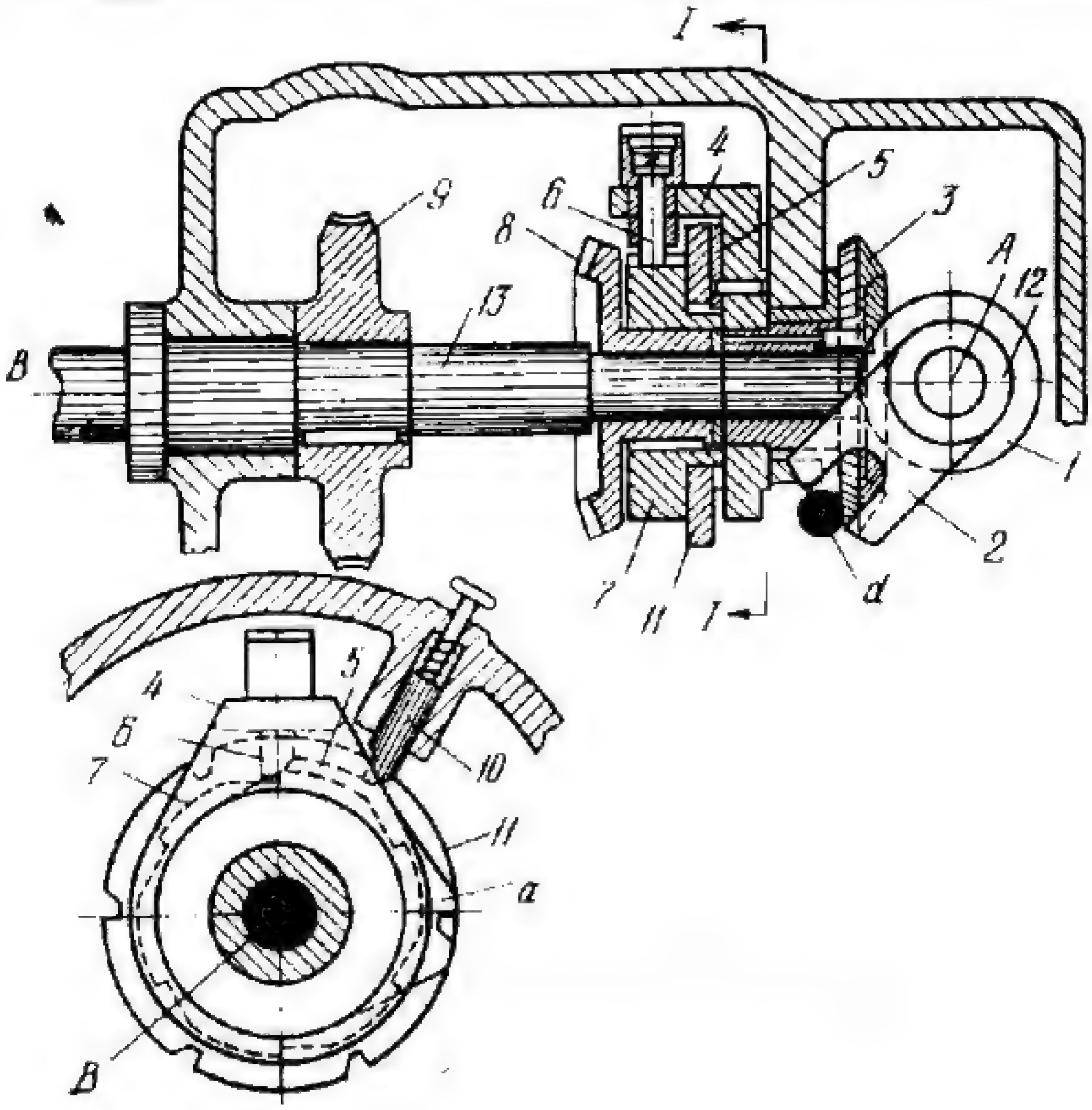


Plate cam *1* rotates about fixed axis *A* and its contour slides along profiled surface *d-d* of follower *3* which turns about fixed axis *B*. Pawls *a* and *b* of follower *3* alternately engage the teeth of ratchet wheel *4* which rotates about fixed axis C. When cam *1* rotates, pawl *a* turns ratchet wheel *4* which is rigidly attached to the type wheel (not shown). As follower *3* swings back by the action of spring *2*, pawl *b* turns ratchet wheel *4* further in the same direction.

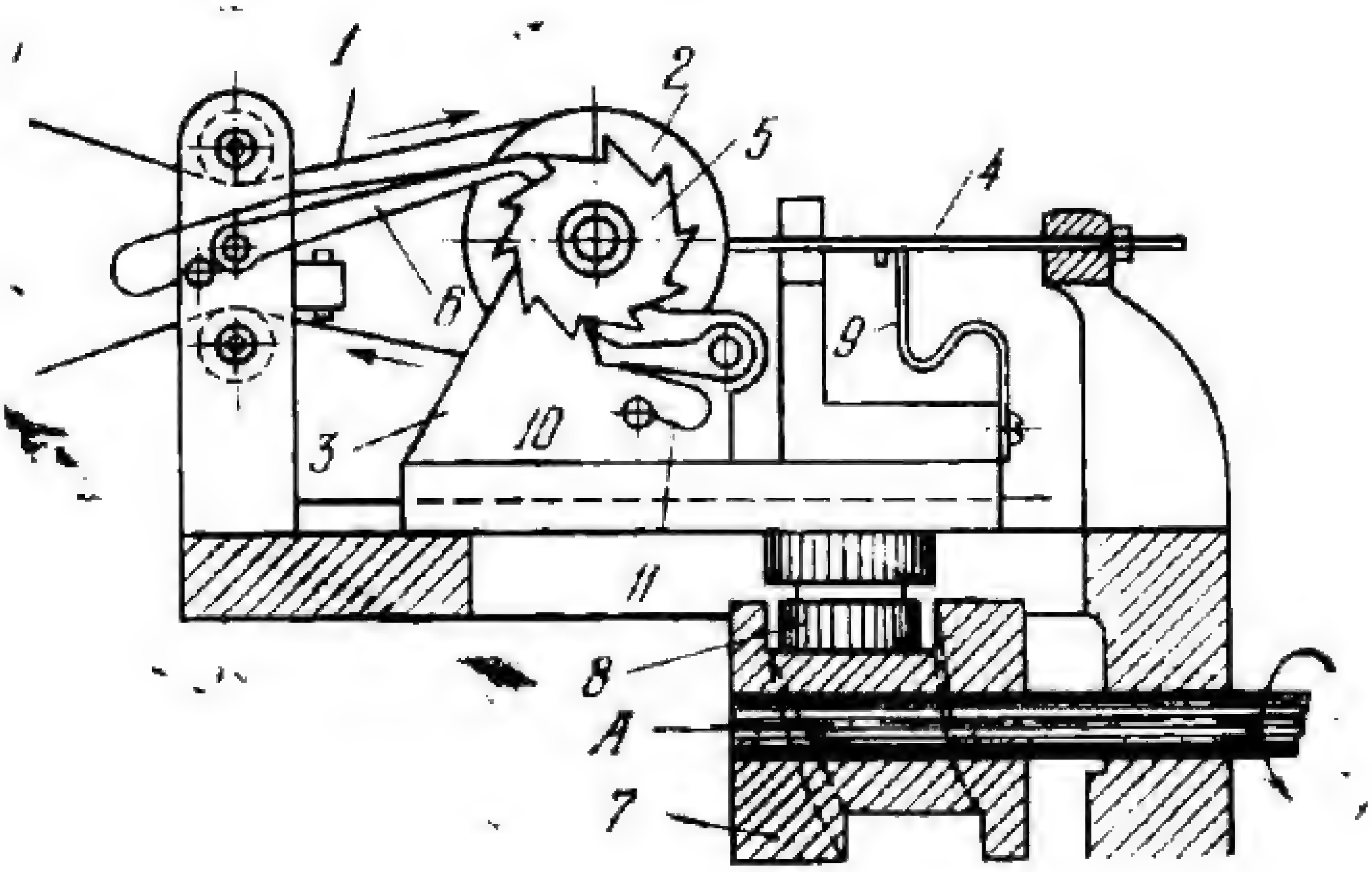
3356	**CAM-RATCHET MECHANISM OF AN AUTOMATIC INDEXING HEAD**	CR FD



Section I-I

The housing of the indexing head is fastened to the reciprocating table of the machine. Keyed to shaft *12* and turning about axis *A*, are forked lever *2*, extending from the side of the head, and bevel gear *1*. In the reciprocation of the head, lever *2*, outside the housing, engages fixed pin *d*, secured to the machine base, and is turned through a definite angle. Bevel gear *3* is rigidly attached to arm *4* which rotates freely on shaft *13* about axis *B* and carries spring-loaded pawl *6*. This pawl engages ratchet wheel *7* which is keyed on bevel gear *8*. Locking ring *11* is keyed to ratchet wheel *7* and is engaged by spring-actuated plunger *10* in the housing. Cam *5* is pinned to arm *4*. Plunger *10* is wide enough so that it contacts cam *5* and is lifted by the cam out of engagement with locking ring *11*. When the head travels to the right, lever *2* is turned clockwise, gear *3*, arm *4* and cam *5* are also turned clockwise. Pawl *6*, engaging a tooth of ratchet wheel *7* turns it together with bevel gear *8* through the required angle. This rotation is transmitted by gearing (not shown) to worm wheel *9* and shaft *13*, to the left end of which the workpiece is fastened. The shaft is held in its indexed position by plunger *10* and the workpiece is machined while the head travels to the left. Near the end of this stroke, lobe *a* of cam *5* lifts plunger *10* out of engagement with locking ring *11* just before pawl *6* engages the next tooth on ratchet wheel *7*.

3357	CAM-RATCHET MECHANISM OF TYPE-PRINTING APPARATUS	CR FD



Punched tape *1* passes over tape-transport roll *2* which is mounted on carriage *3*. As carriage *3* travels to the right, roll *2* with tape *1* approaches link *4*. If link *4* is opposite a hole punched in the tape, then the link remains stationary. As carriage *3* travels to the left, ratchet wheel *5* runs up against pawl *6*, mounted on the base, and is turned through an angle corresponding to one tooth. This moves the tape one pitch. Carriage *3* is reciprocated by cylinder cam *7* which is keyed to driving shaft *A*. Roller *8* of carriage *3* rolls and slides along the groove of cam *7*. Spring *9* returns link *4* to its initial position. Pawl *10* and spring *11* prevent unintentional rotation of ratchet wheel *5*.

3358	CAM-RATCHET TAPE-TRANSPORT MECHANISM IN TELEGRAPH APPARATUS	CR FD

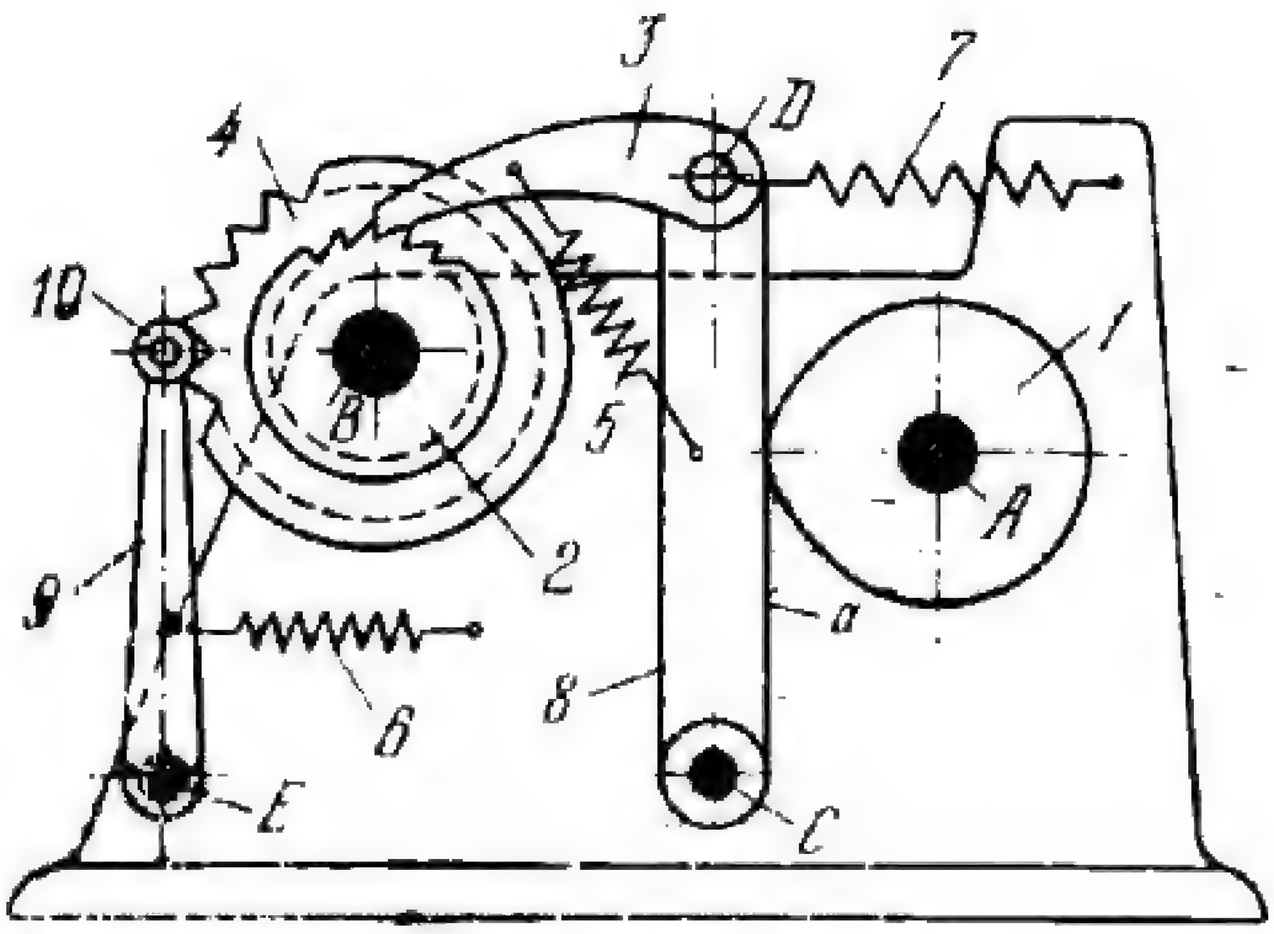
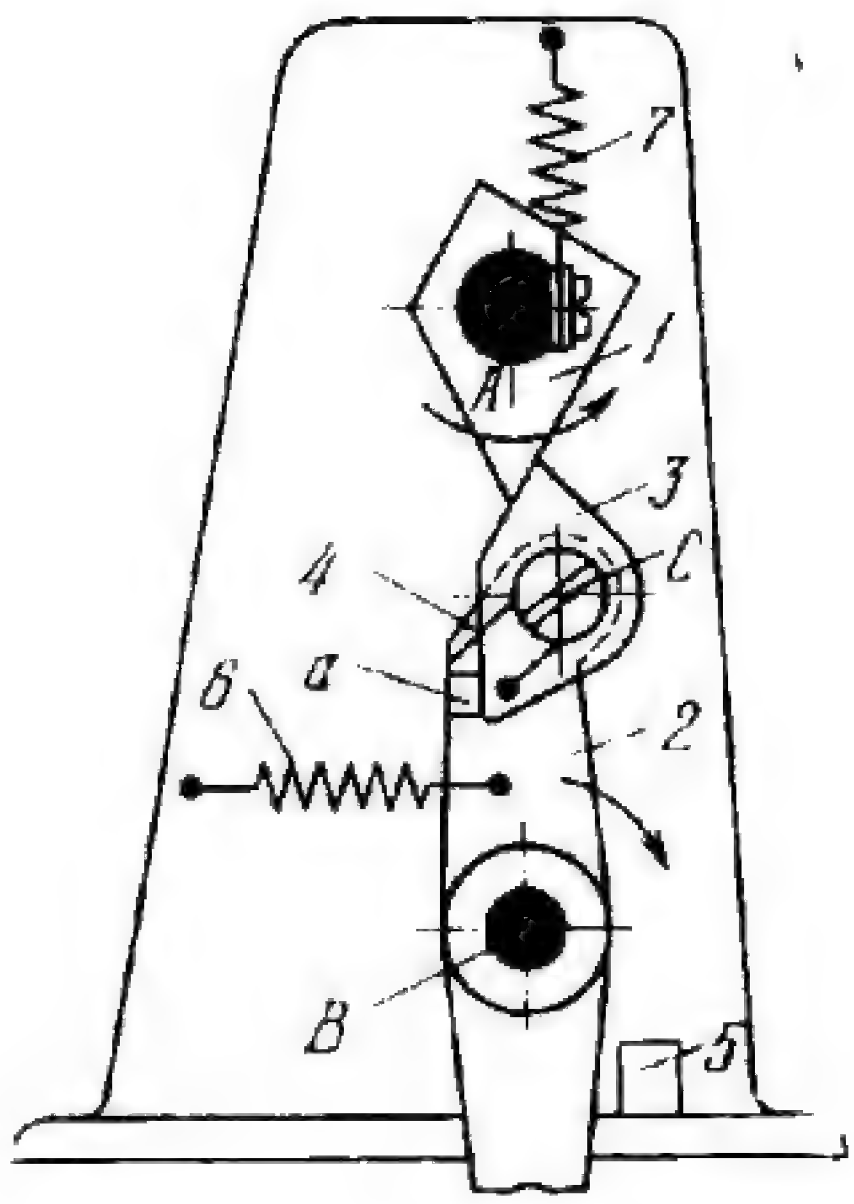


Plate cam *1* rotates about fixed axis *A* and its contour slides along surface *a* of follower *8* which turns about fixed axis *C*. Pawl *3* turns about axis *D* of follower *8* and engages the teeth of ratchet wheel *2* which rotates about fixed axis *B* and is rigidly attached to toothed wheel *4* with triangular teeth. Link *9* turns about fixed axis *E* and carries roller *10* which enters the tooth spaces of wheel *4*. Follower *8*, pawl *3* and roller *10* are held in contact with cam *1*, ratchet wheel *2* and toothed wheel *4* by springs *7*, *5* and *6*. When cam *1* rotates continuously, pawl *3* rotates ratchet wheel *2* and toothed wheel *4* intermittently, imparting an intermittent transport motion to the paper tape running over a roll rigidly attached to wheel *4*.

3359	**CAM-RATCHET STAMP DRIVE MECHANISM FOR A TIME CLOCK**	CR FD



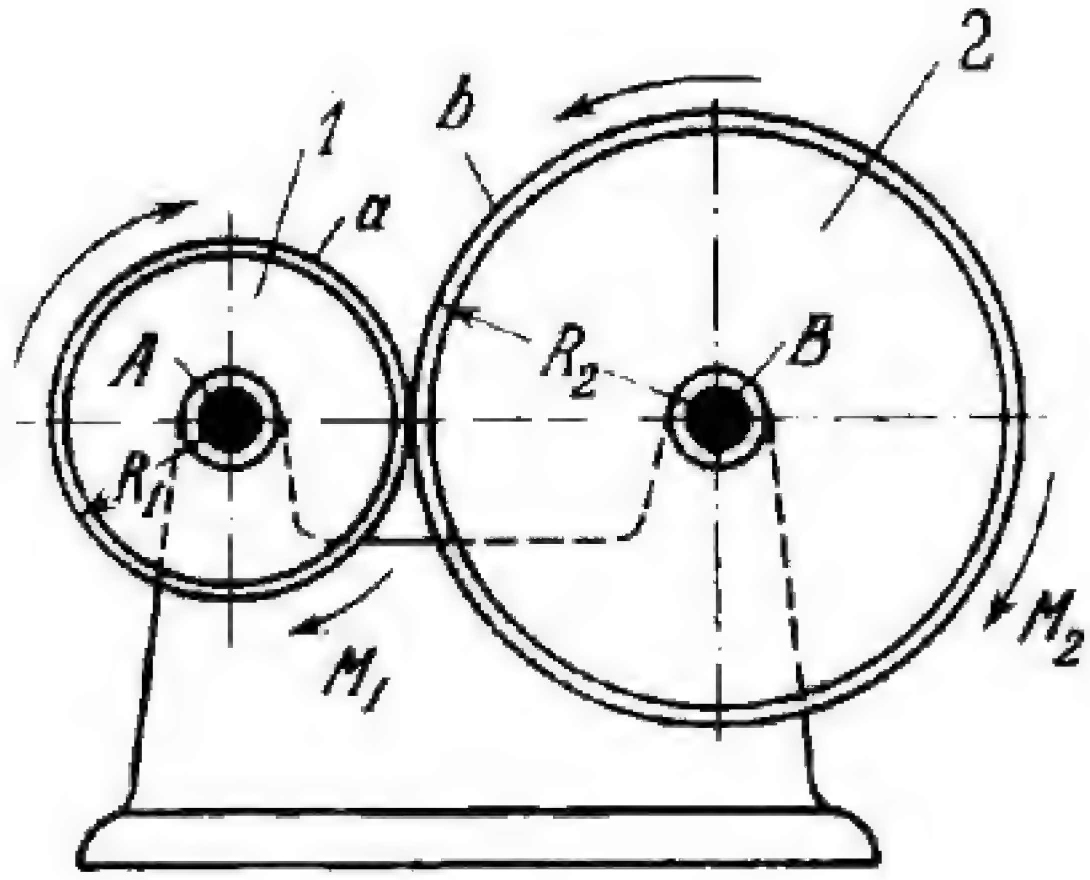
Cam *1* turns about fixed axis *A*. Lever *2* turns about fixed axis *B* and carries pawl *3* which contacts cam *1*. When cam *1* is turned counterclockwise, lever *2* turns clockwise until pawl *3* slips off cam *1* and lever *2* is returned by spring *6* against stop *5*. At this, a spring (not shown), connected to lever *2*, operates the stamp of the time clock. When the handle of the clock is released, spring *7* turns cam *1* clockwise, and pawl *3* turns about axis *C* to allow cam *1* to pass by so that all the links are again in the initial position.

SECTION TWENTY-FOUR

Simple Friction Mechanisms SmF

1. General-Purpose Three-Link Mechanisms 3L (3360 through 3369)
2. General-Purpose Multiple-Link Mechanisms ML (3370 through 3376)
3. Brake Mechanisms Br (3377 through 3391)
4. Stop, Detent and Locking Mechanisms SD (3392 through 3396)
5. Sorting and Feeding Mechanisms SF (3397 through 3400)
6. Clutch and Coupling Mechanisms C (3401 through 3412)
7. Governor Mechanisms G (3413)
8. Gripping, Clamping and Expanding Mechanisms GC (3414)
9. Mechanisms of Other Functional Devices FD (3415 and 3416)

3360	THREE-LINK SPUR FRICTION WHEEL DRIVE MECHANISM	SmF 3L



Friction wheel *1* rotates about fixed axis A and the elements of its external cylindrical surface a contact the elements of external cylindrical surface b of friction wheel *2* which rotates about fixed axis B. The transmission ratio between wheels *1* and *2* without slippage is

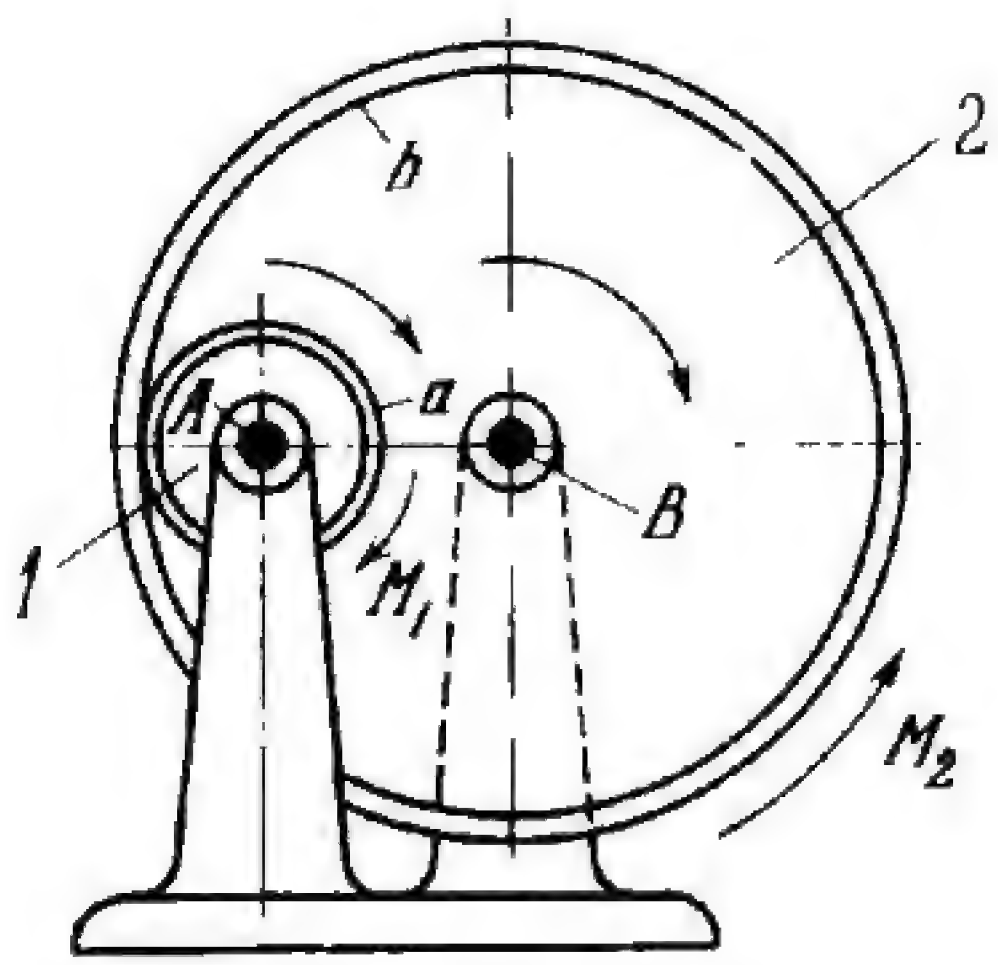
$$i_{12} = -\frac{n_1}{n_2} = -\frac{R_2}{R_1}$$

where n_1 and n_2 are the speeds (in rpm) and R_1 and R_2 are the radii of friction wheels *1* and *2*. Rotation is transmitted between wheels *1* and *2* by friction between surfaces a and b. The torque M_1 on driving wheel *1* is related to torque M_2 transmitted to driven wheel *2* by the equation

$$Q \geqslant \frac{M_1 \varkappa}{f R_1} = \frac{M_2 \varkappa}{f R_2}$$

where Q is the normal force applied between the wheels (along line AB), $\varkappa = 1.5$ to 2 is the traction assurance factor and f is the coefficient of sliding friction between surfaces a and b.

3361	THREE-LINK INTERNAL FRICTION WHEEL DRIVE MECHANISM	SmF 3L



Friction wheel 1 rotates about fixed axis A and the elements of its external cylindrical surface a contact the elements of internal cylindrical surface b of friction wheel 2 which rotates about fixed axis B. The transmission ratio between wheels 1 and 2 without slippage is

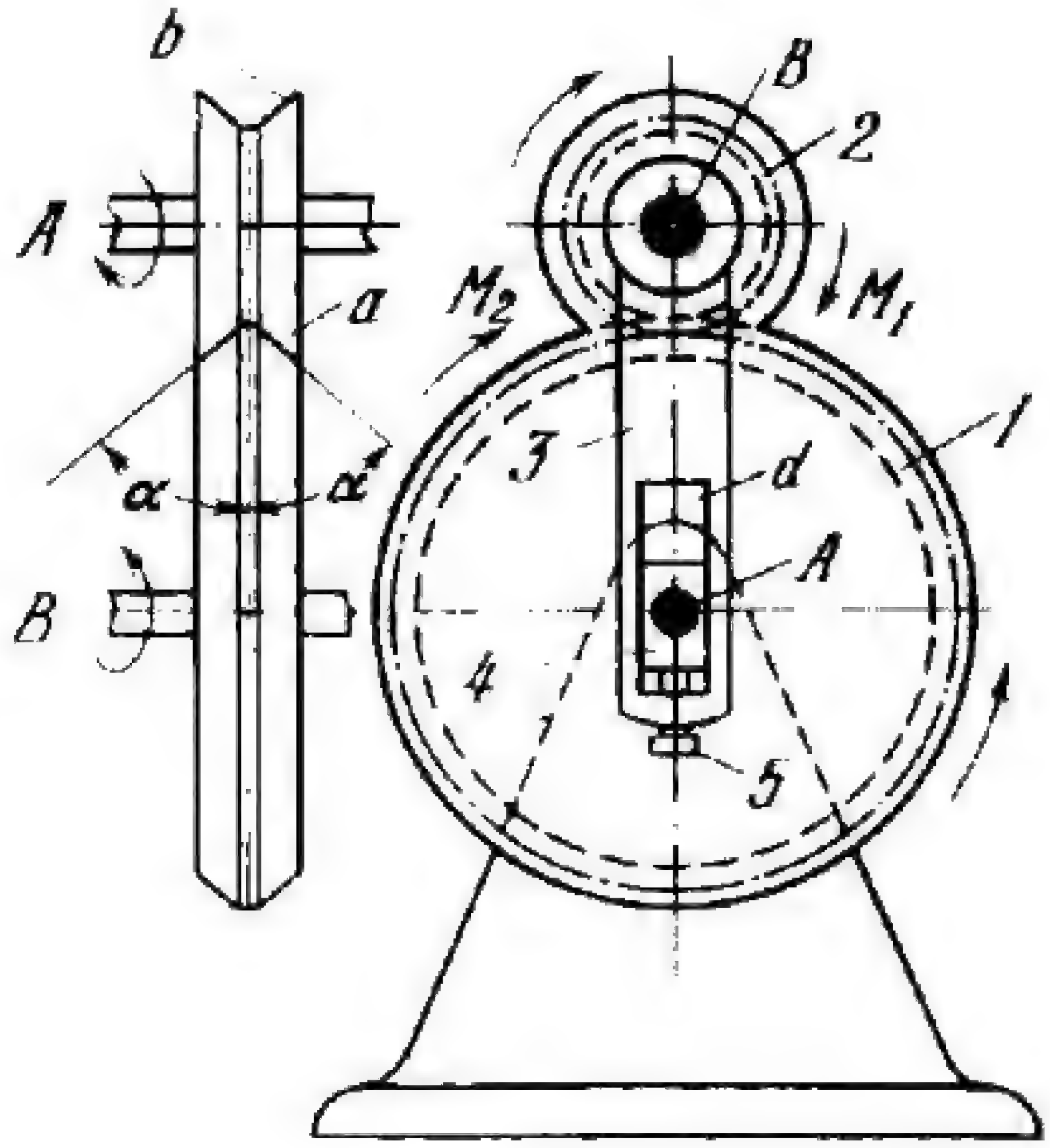
$$i_{12} = \frac{n_1}{n_2} = \frac{R_2}{R_1}$$

where n_1 and n_2 are the speeds (in rpm) and R_1 and R_2 are the radii of friction wheels 1 and 2. Rotation is transmitted between wheels 1 and 2 by friction between surfaces a and b. The torque M_1 on driving wheel 1 is related to torque M_2 transmitted to wheel 2 by the equation

$$Q \geqslant \frac{M_1 \varkappa}{f R_1} = \frac{M_2 \varkappa}{f R_2}$$

where Q is the normal force applied between the wheels (along line AB), $\varkappa = 1.5$ to 2 is the traction assurance factor and f is the coefficient of sliding friction between surfaces a and b.

3362	THREE-LINK ADJUSTABLE-PRESSURE EXTERNAL FRICTION WHEEL DRIVE MECHANISM	SmF 3L



Wedge-surface friction wheel *1* rotates about fixed axis *A* and its wedged external surface *a* contacts grooved external surface *b* of grooved friction wheel *2* which rotates about fixed axis *B*. The transmission ratio between wheels *1* and *2* without slippage is

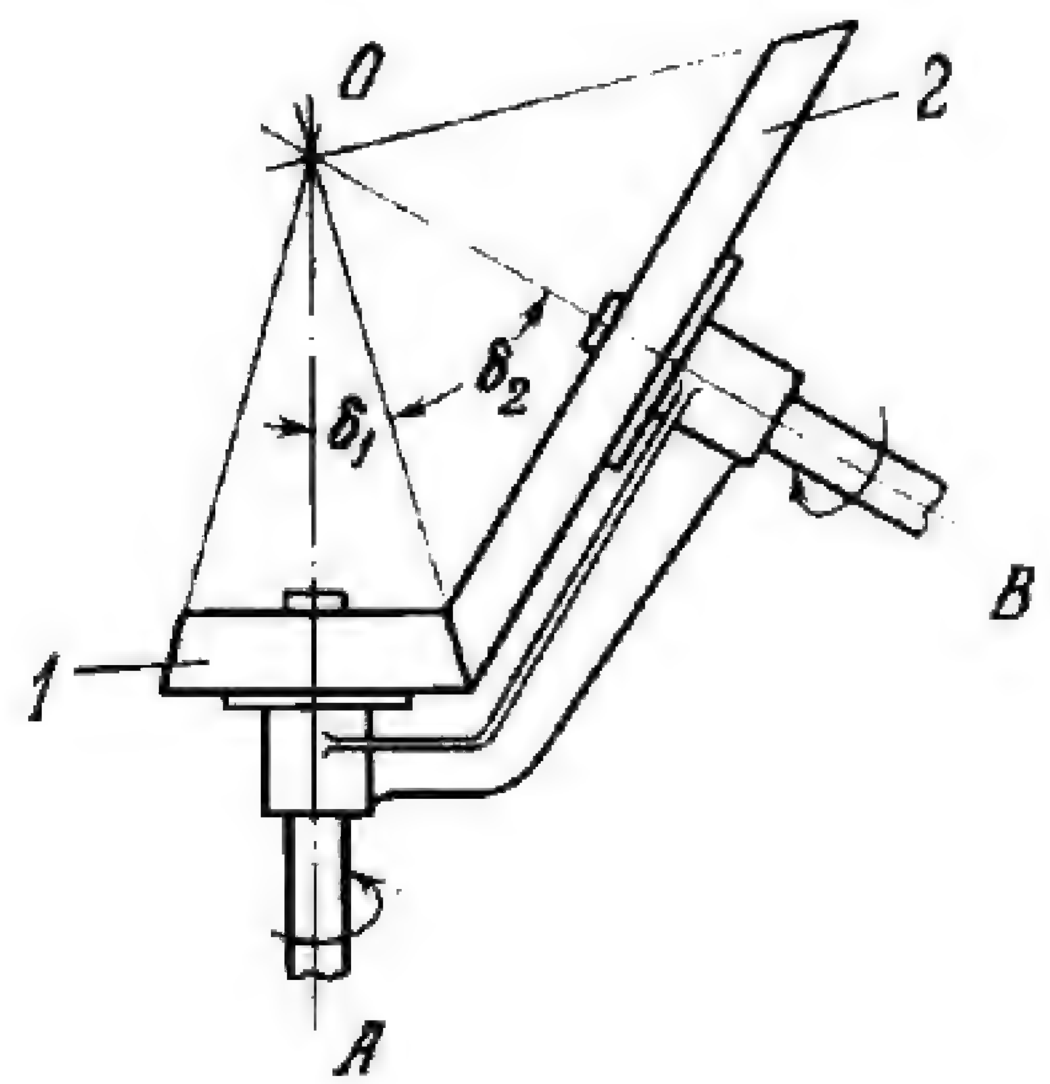
$$i_{12} = -\frac{n_1}{n_2} = -\frac{R_2}{R_1}$$

where n_1 and n_2 are the speeds (in rpm) of wheels *1* and *2* and R_1 and R_2 are the mean radii of the wedge surfaces in contact on wheels *1* and *2*. Rotation is transmitted between wheels *1* and *2* by friction between surfaces of contact *a* and *b*. The torque M_1 on driving wheel *1* is related to torque M_2 tramsmitted to wheel *2* by the equation

$$Q \geqslant \frac{M_1 \varkappa \sin\alpha}{fR_1} = \frac{M_2 \varkappa \sin\alpha}{fR_2}$$

where Q is the normal force applied between the wheels (along line AB), $\varkappa = 1.5$ to 2 is the traction assurance factor, f is the coefficient of sliding friction between surfaces *a* and *b*, and α is the angle shown. The force Q exerted between the wheels is varied by means of link *3* which is connected by turning pair *B* to wheel *2* and by a sliding pair to slider *4*. Slider *4* turns about axis *A*. Screw device *5* regulates force Q by moving slider *4* along slot *d* of link *3*.

3363	THREE-LINK EXTERNAL BEVEL FRICTION WHEEL DRIVE MECHANISM	SmF 3L



Bevel friction wheel *1* rotates about fixed axis *A* and its external conical surface contacts the external conical surface of bevel friction wheel *2* which rotates about fixed axis *B*. The transmission ratio between wheels *1* and *2* without slippage is

$$i_{12} = -\frac{n_1}{n_2} = -\frac{\sin\delta_2}{\sin\delta_1}$$

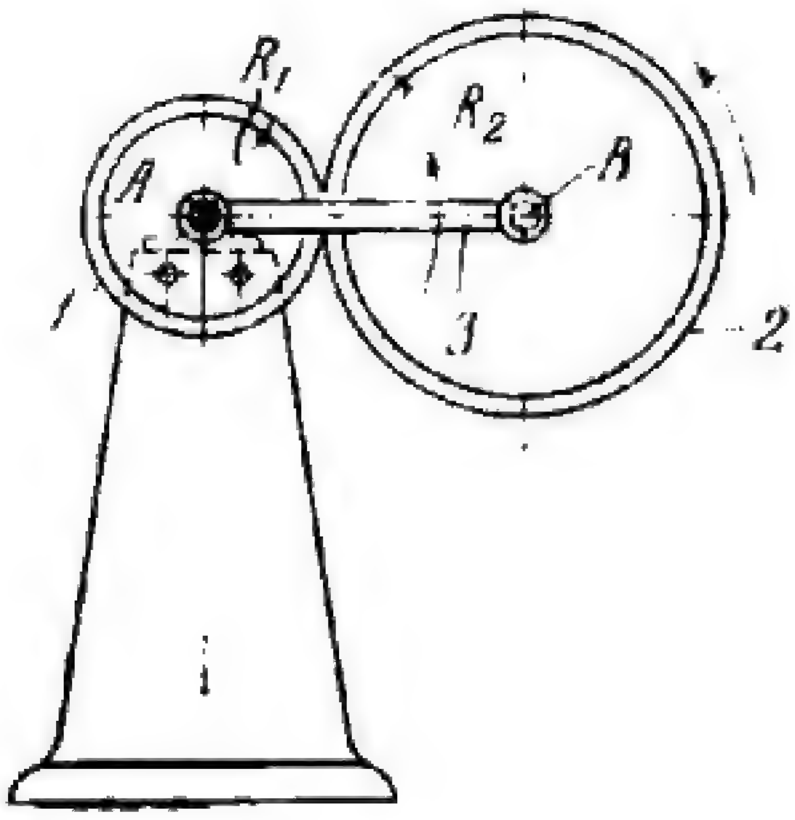
where n_1 and n_2 are the speeds (in rpm) and δ_1 and δ_2 are the face angles of wheels *1* and *2*. The torque M_1 on driving wheel *1* and the torque M_2 transmitted to wheel *2* are related to the required forces Q_1 and Q_2 acting along axes *A* and *B* by the equations

$$Q_1 \geqslant \frac{M_1 \sin\delta_1}{fR_1}\varkappa$$

$$Q_2 \geqslant \frac{M_2 \sin\delta_2}{fR_2}\varkappa$$

where $\varkappa = 1.5$ to 2 is the traction assurance factor, f is the coefficient of sliding friction between the conical surfaces of wheels *1* and *2*, and R_1 and R_2 are the mean radii of wheels *1* and *2*.

3364	THREE-LINK EXTERNAL PLANETARY FRICTION WHEEL MECHANISM	SmF 3L

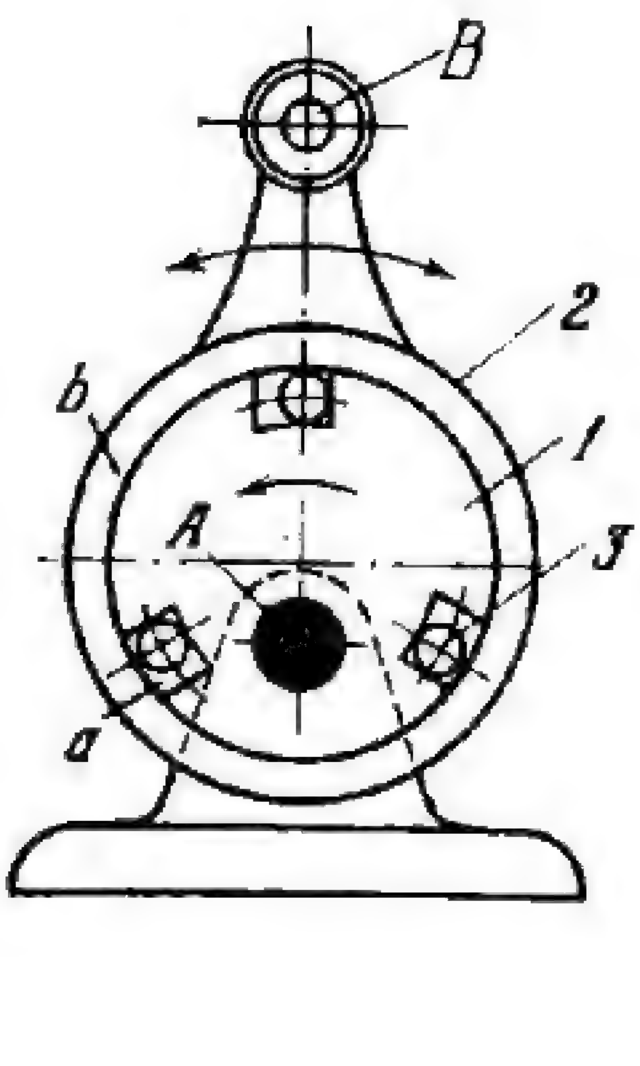


Carrier *3* rotates about fixed axis A and is connected by turning pair B to planet friction wheel *2* which contacts and rolls around the external cylindrical surface of fixed sun friction wheel *1*. The speeds n_2 and n_3 (in rpm) without slippage of wheel *2* and carrier *3* are related by the condition

$$n_2 = n_3 \frac{R_1 + R_2}{R_2}$$

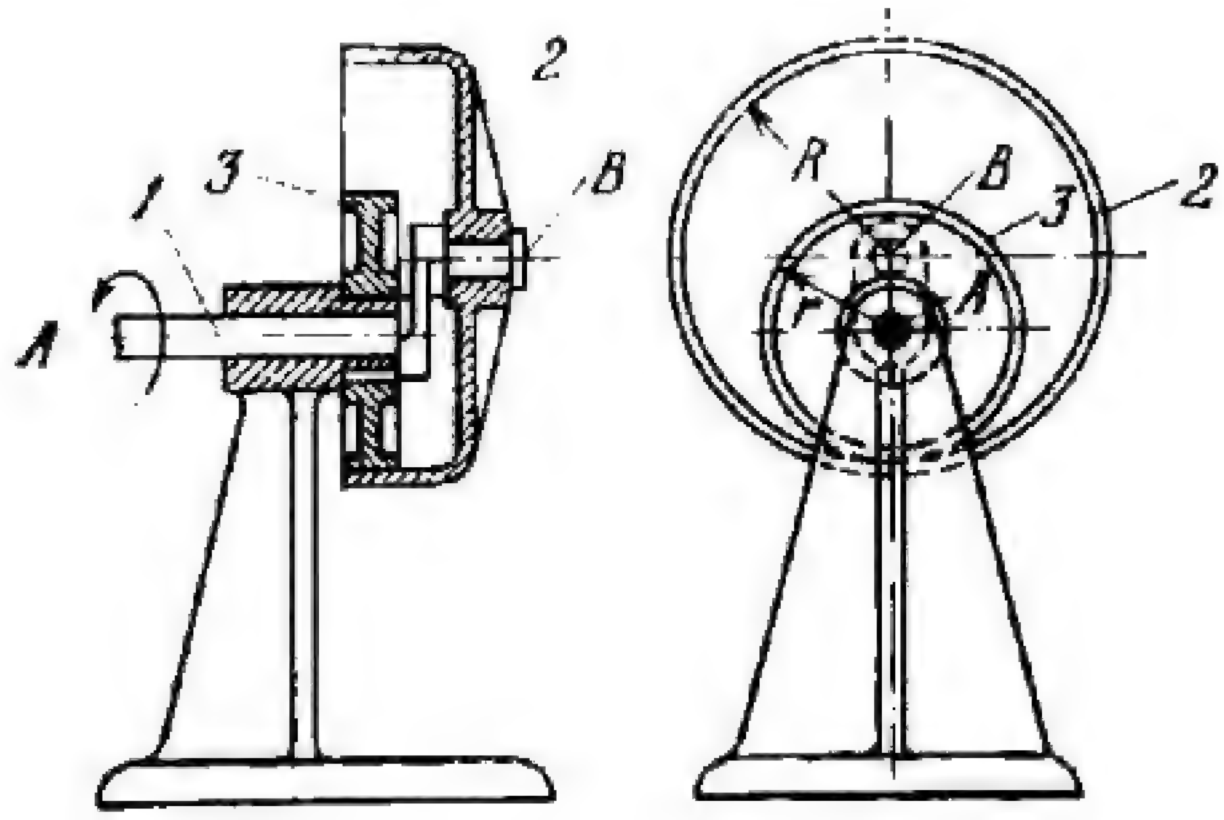
where R_1 and R_2 are the radii of wheels *1* and *2*.

3365	COMBINED ECCENTRIC AND FRICTION RATCHET MECHANISM FOR VARIABLE FEED MOTION	SmF 3L



Eccentric *1* rotates about fixed axis A and has wedge-shaped grooves a containing rollers *3*. Eccentric *1* is encircled by collar b of link *2* which is oscillated by a drive (not shown). When link *2* turns counterclockwise, rollers *3* are jammed between eccentric *1* and collar b so that eccentric *1* is turned clockwise through a certain angle. As link *2* swings back, rollers *3* are released and eccentric *1* and its shaft remain stationary. Since, as eccentric *1* is turned about axis A, distance $\overline{AB}$ is gradually varied from minimum to maximum and back again, the angle of rotation of the eccentric and its shaft varies likewise.

3366	THREE-LINK INTERNAL PLANETARY FRICTION WHEEL MECHANISM	SmF 3L

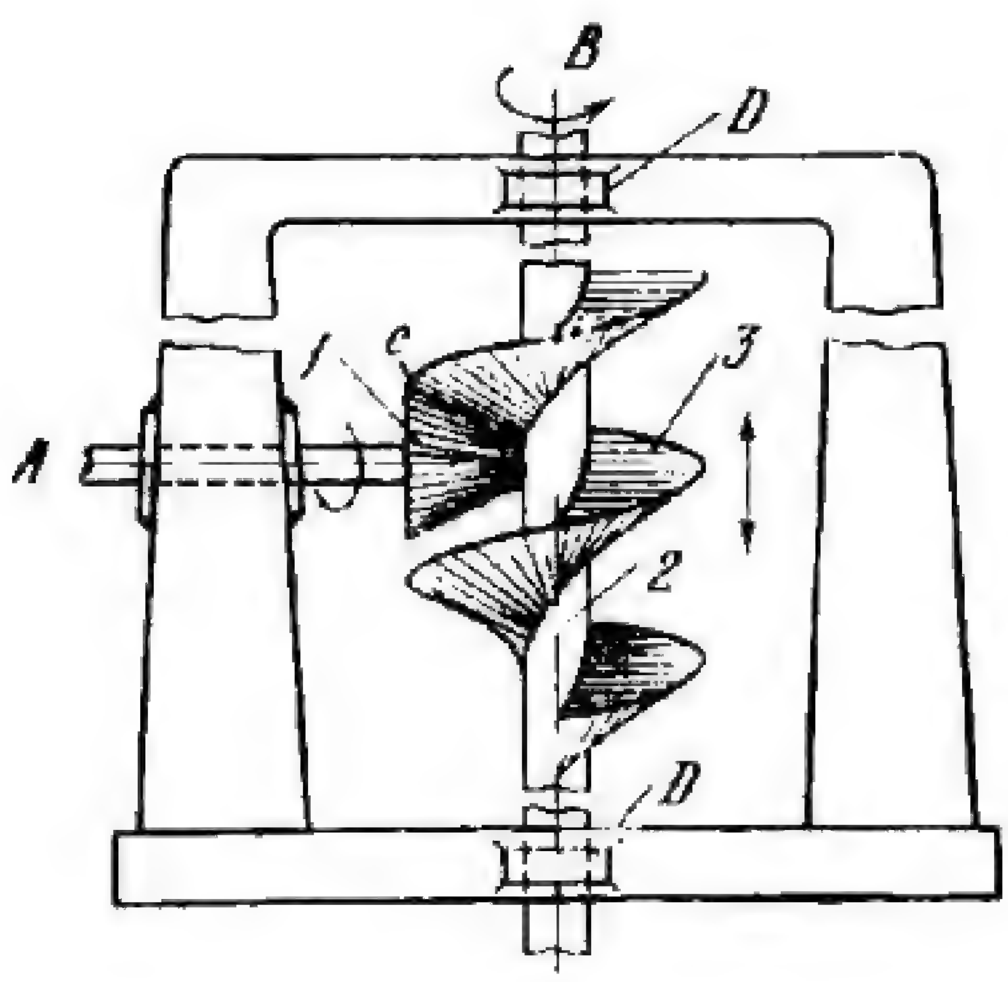


Carrier 1 rotates about fixed axis A and is connected by turning pair B to internal friction wheel 2 which contacts and rolls around fixed friction wheel 3. The speeds n_1 and n_2 (in rpm) without slippage of carrier 1 and wheel 2 are related by the condition:

$$n_2 = n_1 \frac{R-r}{R}$$

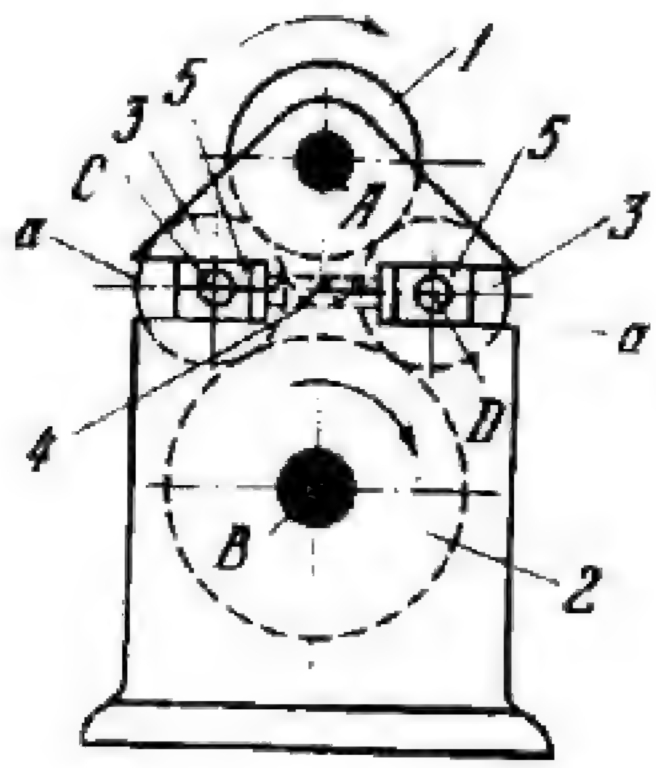
where R and r are the radii of wheels 2 and 3.

3367	HELICAL FRICTION DRIVE MECHANISM	SmF 3L



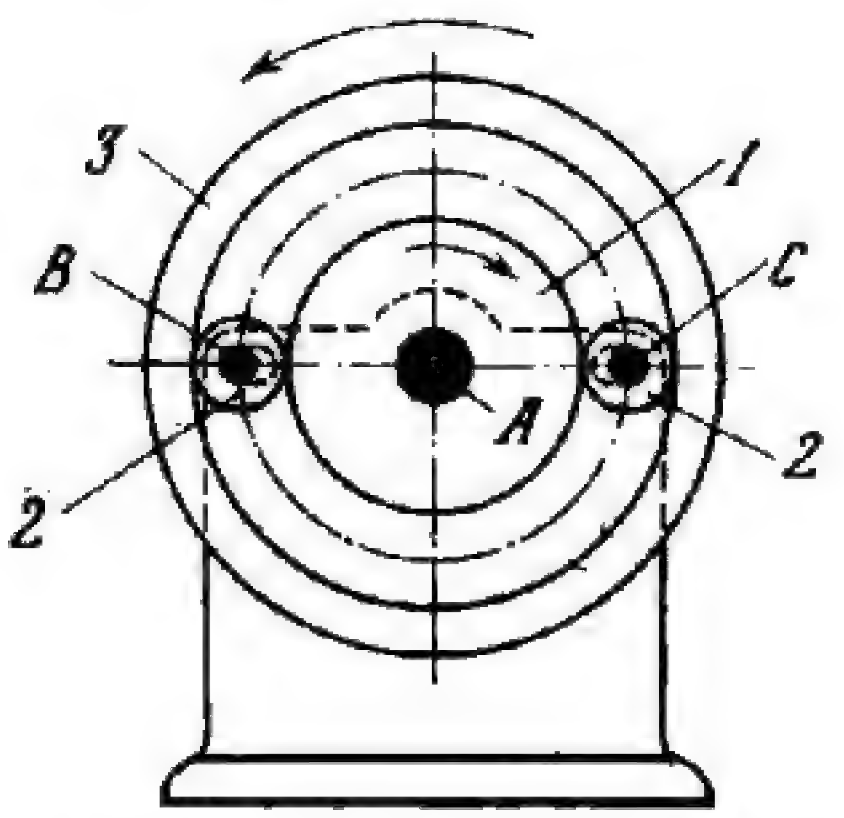
Bevel friction wheel 1 rotates about fixed axis A and contacts, along line c, the profiled helical surface 3 of link 2. Link 2 slides axially in fixed guides D-D and rotates in these guides about fixed axis B. When wheel 1 rotates, link 2 has a helical motion.

3368	PRESSURE-ROLLER FRICTION DRIVE MECHANISM	SmF 3L



Friction wheel *1* rotates about fixed axis *A* and contacts two pressure rollers *3* of equal diameter which rotate about axes *C* and *D* of sliders *5*. Sliders *5* move along fixed guides *a*. Friction wheel *2* rotates about fixed axis *B* and is driven by wheel *1* through pressure rollers *3*. The required normal force for transmitting a torque is developed by spring *4* which connects sliders *5*.

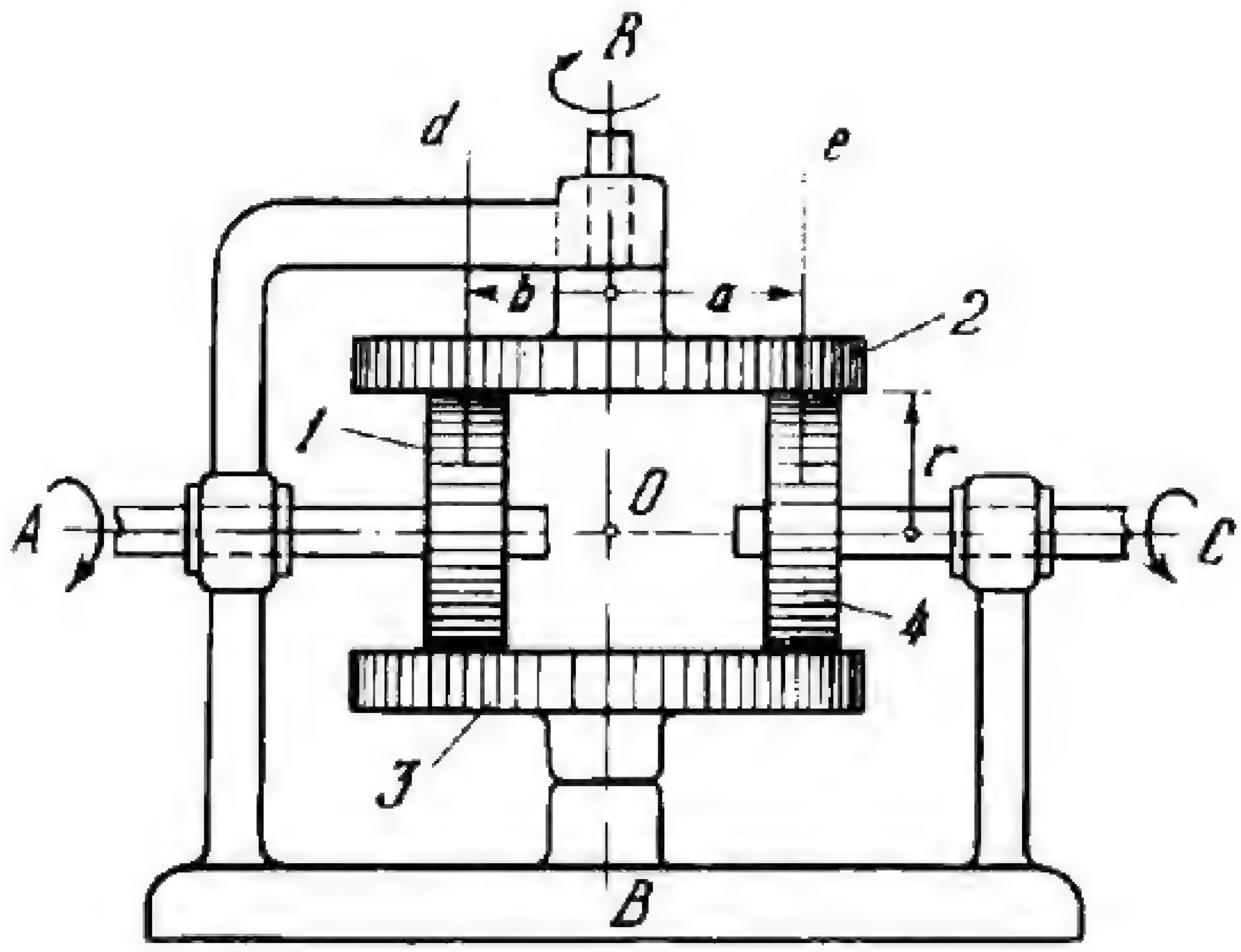
3369	DRIVEN-RING FRICTION DRIVE MECHANISM	SmF 3L



Friction wheel *1* rotates about fixed axis *A* and contacts two rollers *2* of equal diameter which rotate about fixed axes *B* and *C*. Ring *3* is freely mounted on rollers *2*. Rotation is transmitted from wheel *1* to ring *3* through rollers *2*. The required normal force for transmitting a torque is developed by the weight of ring *3* which rests on the rollers.

2. GENERAL-PURPOSE MULTIPLE-LINK MECHANISMS
(3370 through 3376)

3370	FRICTION PLATE AND WHEEL DRIVE MECHANISM	SmF ML

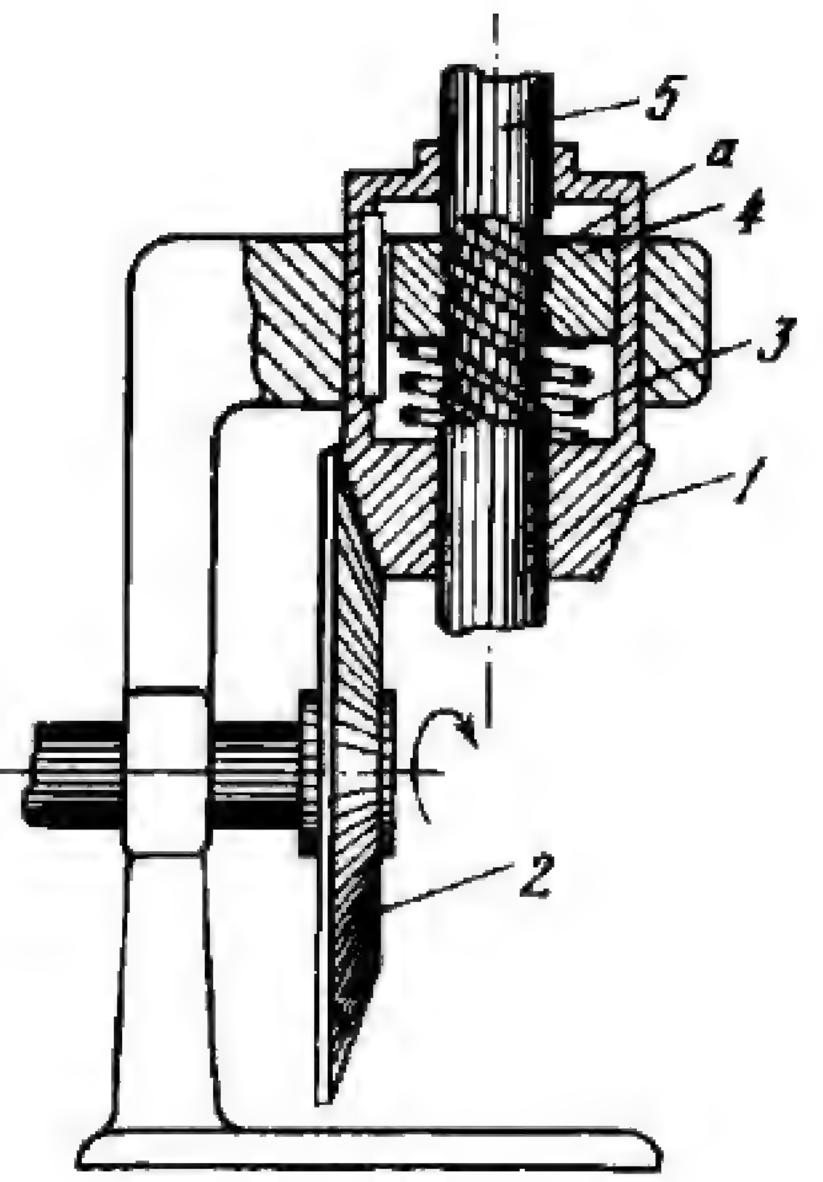


Friction wheel *1* rotates about fixed axis A and its external cylindrical surface contacts the faces of friction plates *2* and *3* which rotate about fixed axes B. The faces of plates *2* and *3* contact the elements of the cylindrical surface of friction wheel *4* which rotates about fixed axis C. The speeds n_1 and n_4 (in rpm) without slippage of wheels *1* and *4* are related by the condition:

$$n_4 = -n_1 \frac{a}{b}$$

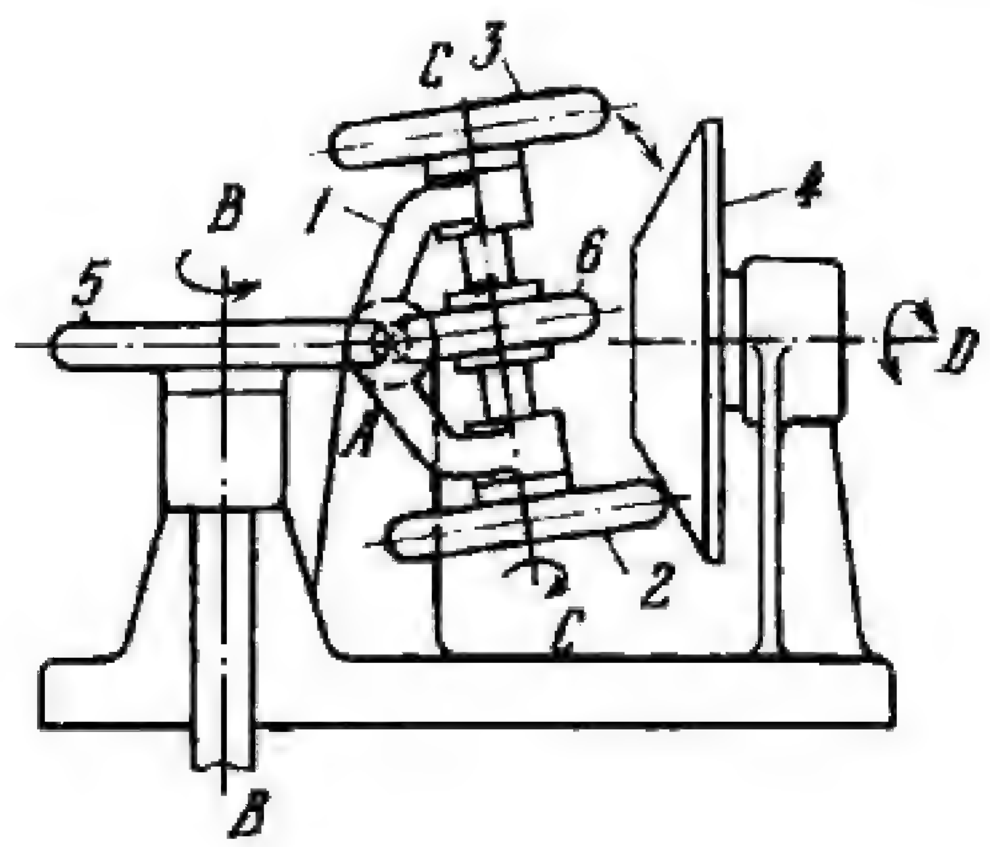
where b and a are the distances from centrelines d and e of wheels *1* and *4* to axis B. This relationship concerns only the central sections of wheels *1* and *4* through lines d and e. Slippage occurs at all other points of contact of wheels *1* and *4* with plates *2* and *3*. Looking along their axes, wheels *1* and *4* rotate in opposite directions.

3371	BEVEL FRICTION DRIVE MECHANISM WITH AUTOMATIC NORMAL PRESSURE ADJUSTMENT	SmF ML



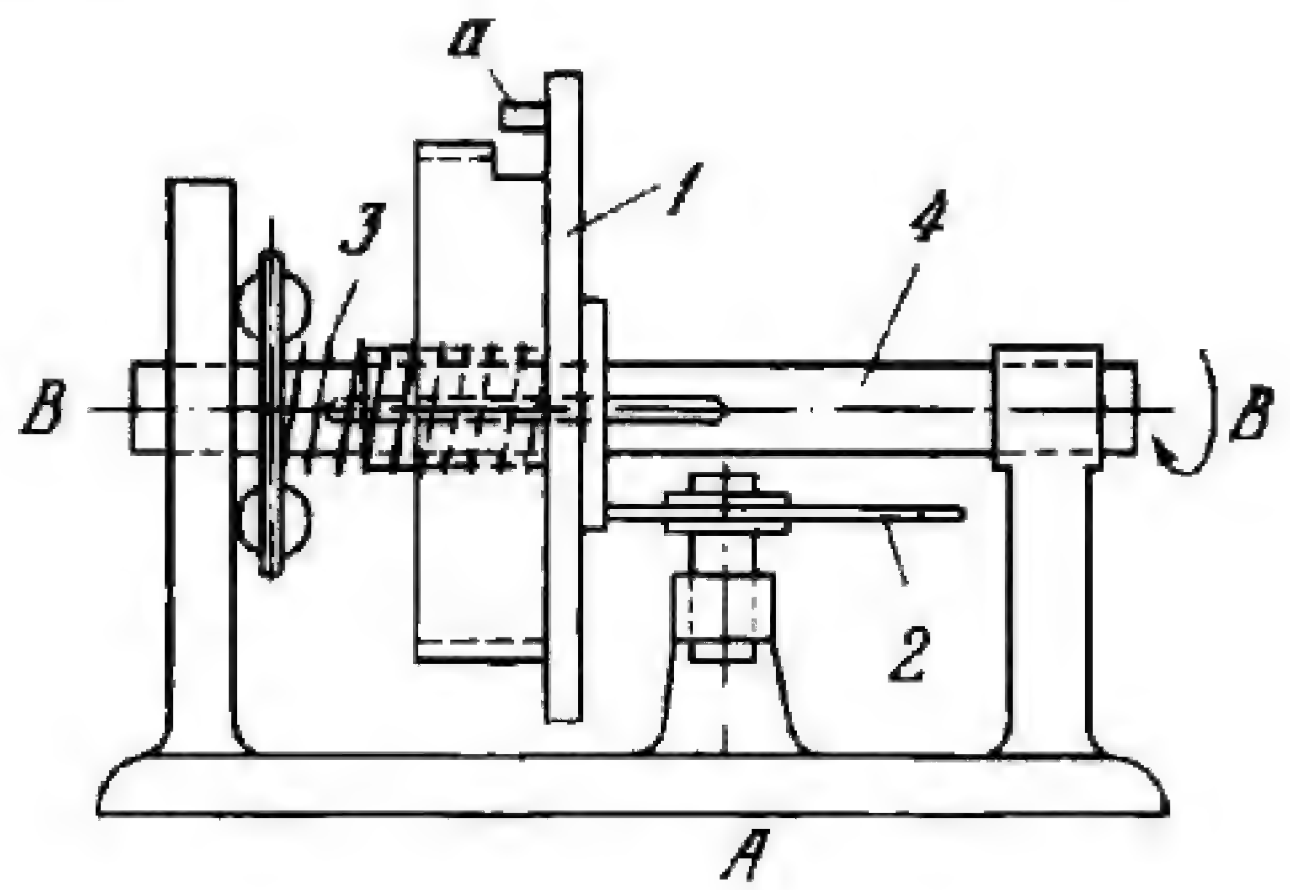
Bevel friction wheel *2* transmits rotation to bevel friction wheel *1* which rotates together with shaft *5*. The required normal pressure between wheels *1* and *2* is developed by spring *3*. At normal load, nut *4*, spring *3* and wheel *1* all rotate together with shaft *5*. When the load is increased, shaft *5* is slowed down with respect to wheel *1* and nut *4*, which slides in wheel *1* along a feather key, so that nut *4* moves downward along thread *a* of shaft *5*, increasing the compression of spring *3* and the normal pressure between the friction wheels. The opposite occurs when the load is reduced.

3372	FRICTION DRIVE REVERSING MECHANISM	SmF ML



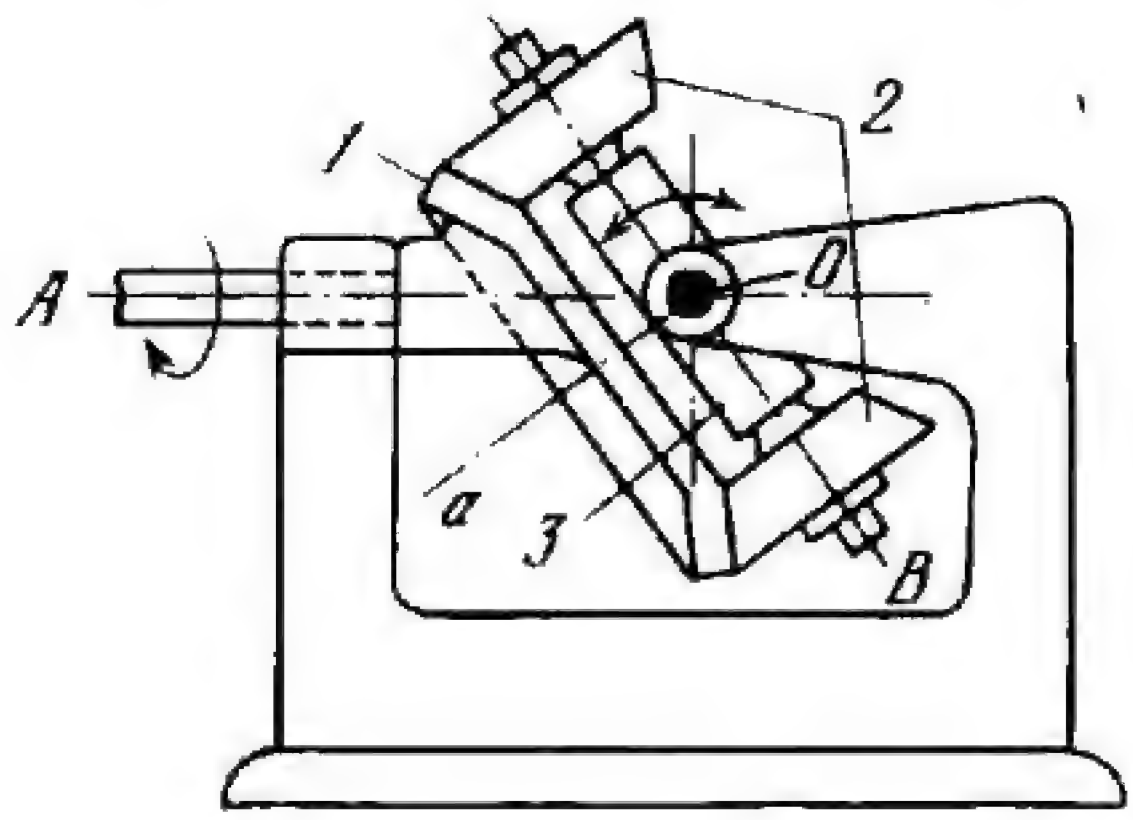
Friction wheel *5* rotates about fixed axis *B-B* and contacts friction wheel *6* which rotates about axis *C-C* of frame *1*. Rigidly attached to wheel *6* are two friction wheels, *2* and *3*, of equal diameter. Frame *1* with wheels *2*, *3* and *6* can be swivelled about fixed axis *A* to bring either wheel *2* or *3* into contact with bevel friction wheel *4* which rotates about fixed axis *D*. Wheel *4* rotates in either direction depending upon which wheel, *2* or *3*, it is in contact with.

3373	SHCHEKUDOV FRICTION MECHANISM WITH TWO ECCENTRICS	SmF ML



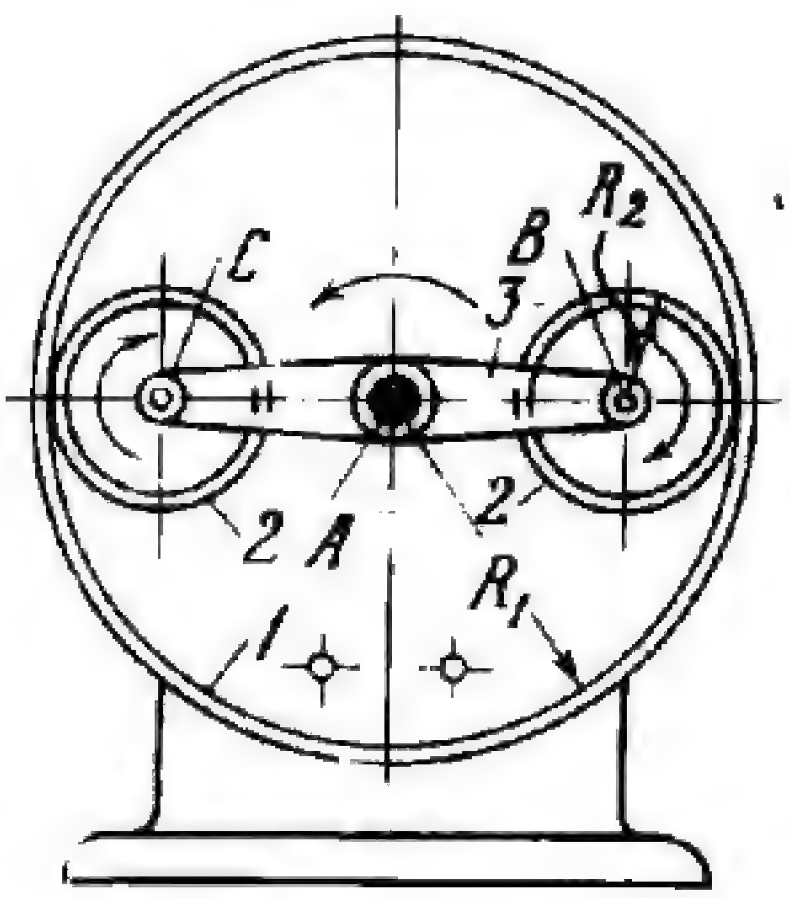
Eccentric *1* rotates about fixed axis *B-B* and slides along this axis on a feather key of shaft *4*. Eccentric *2* rotates about fixed axis *A* and moves eccentric *1* along shaft *4*. In a definite position of eccentric *1* its pin *a* engages the slot of a Geneva wheel (not shown) and stops the wheel. Eccentric *1* is held against eccentric *2* by spring *3*.

3374	SWIVEL-LINK BEVEL FRICTION WHEEL DRIVE MECHANISM	SmF ML



Bevel friction wheel *1* rotates about fixed axis *A* and has central axis *Oa* which does not coincide with its axis of rotation *A*. Wheel *1* contacts two identical bevel friction wheels *2* which rotate about axis *B* of link *3*. Link *3* turns about fixed axis *O* which is perpendicular to the plane of the drawing and intersects axes *A* and *Oa*. When wheel *1* rotates, link *3* oscillates about axis *O*.

3375	INTERNAL PLANETARY FRICTION WHEEL MECHANISM	SmF ML

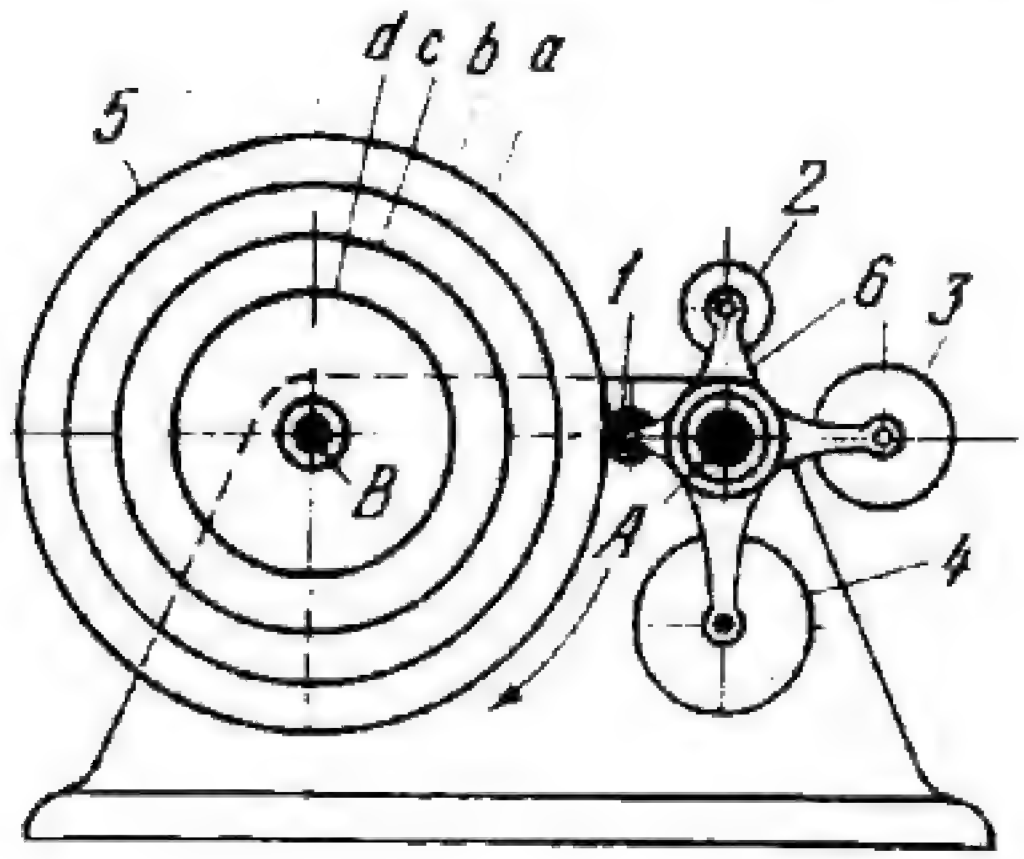


Carrier *3* rotates about fixed axis *A* and is connected by turning pairs *B* and *C* to two identical planet friction wheels *2* which contact and roll around fixed internal friction wheel *1*. The speeds n_2 and n_3 (in rpm) without slippage of wheels *2* and carrier *3* are related by the condition:

$$n_2 = -n_3 \frac{R_1 - R_2}{R_2}$$

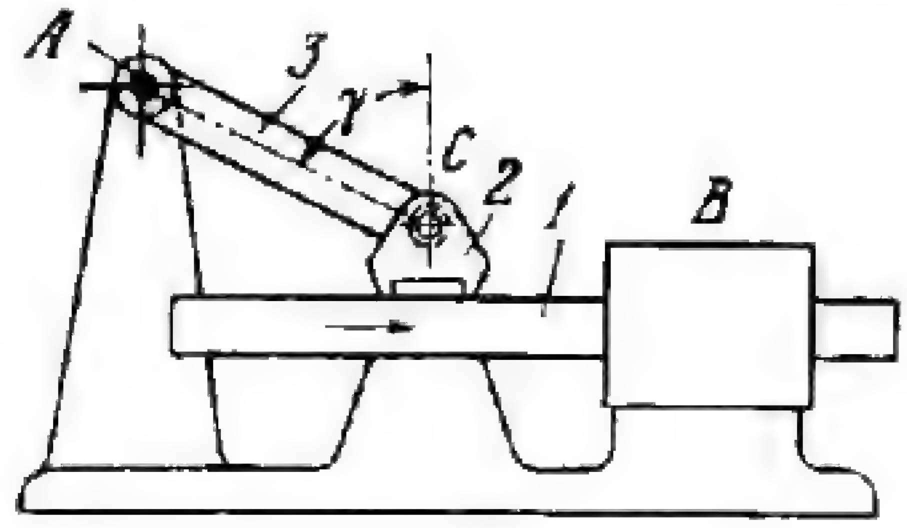
where R_1 and R_2 are the radii of wheels *1* and *2*. Two symmetrically located planet wheels *2* balance the dynamic pressure exerted on the bearing of carrier *3*.

3376	VARIABLE-SPEED SPUR FRICTION WHEEL DRIVE MECHANISM	SmF ML



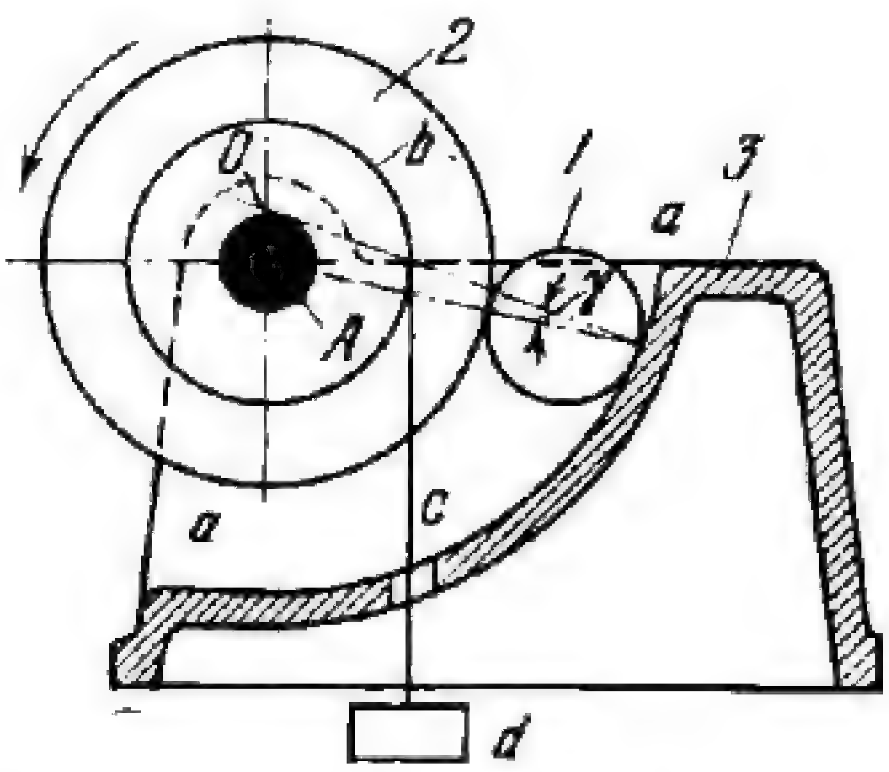
Cross-shaped link *6* turns about fixed axis *A* and carries four friction wheels located in different planes. Stepped friction wheel *5* rotates about fixed axis *B*. Link *6* has four separate indexed positions so that wheel *1* can engage step *a*, wheel *2* step *b*, wheel *3* step *c*, or wheel *4* step *d*. Thus rotation can be transmitted with any one of four different speed ratios.

3377	SELF-ACTING FRICTION BRAKE MECHANISM FOR A SLIDE	SmF Br



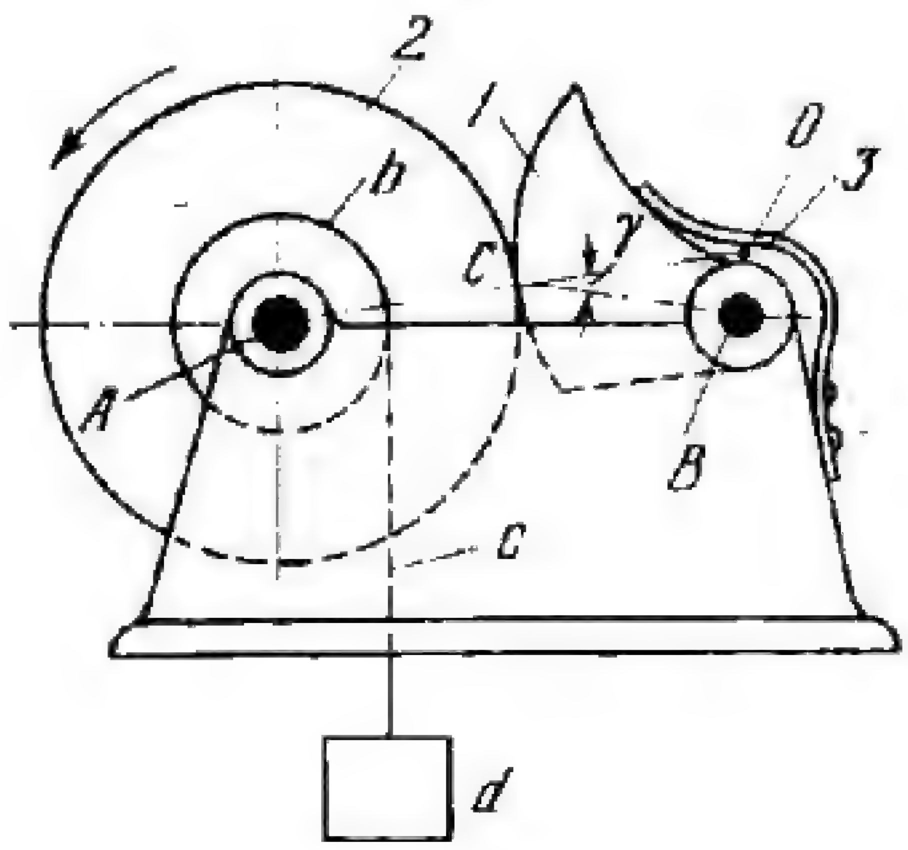
Prismatic slide *1* moves in fixed guide *B* to the right. Lever *3* turns about fixed axis *A* and carries shoe *2* which turns about axis *C* of the lever. Slide *1* cannot travel to the left because shoe *2* jams between slide *1* and lever *3* if angle γ is small enough.

3378	SELF-ACTING FRICTION ROLLER BRAKE MECHANISM OF A HOISTING DRUM	SmF Br



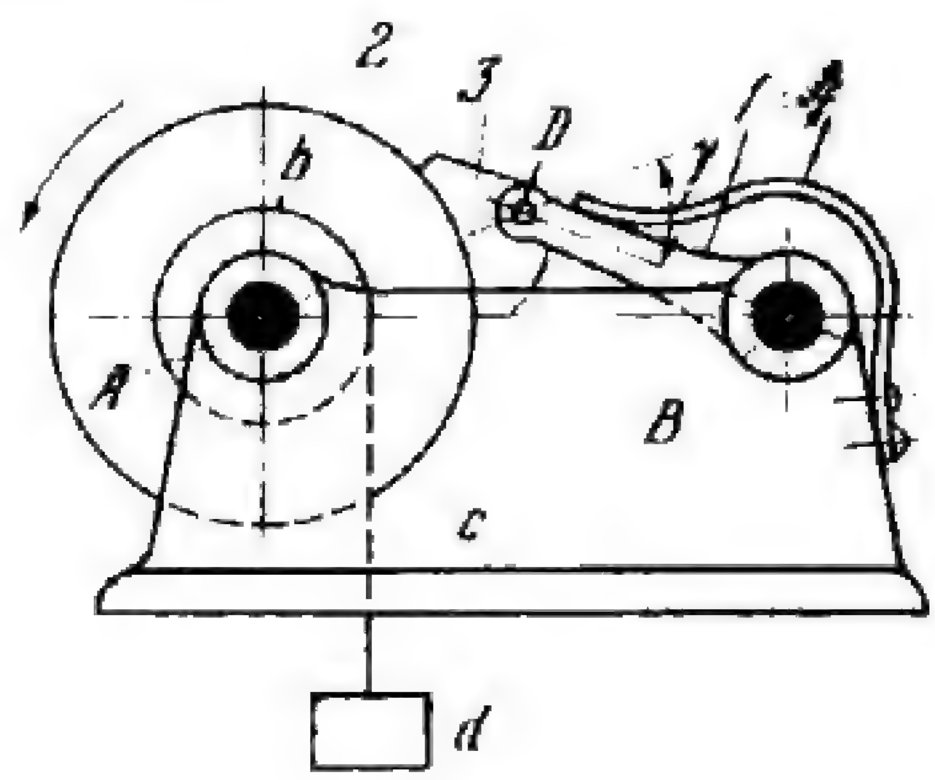
Brake disk *2* rotates about fixed axis *A* and is rigidly attached to drum *b* about which flexible link *c* is wound in hoisting load *d*. The brake disk engages round roller *1* which rolls along a fixed circular recess of the base with a working surface along circular arc *a-a* described from centre *O*. The load is hoisted by rotating the disk and drum counterclockwise. Reverse rotation of disk *2* and the drum (and dropping of the load) is prevented by roller *1* which jams between the disk and arc *a-a* if angle γ has been properly chosen. A ball can be used in place of roller *1*.

3379	SELF-ACTING FRICTION CAM BRAKE MECHANISM OF A HOISTING DRUM	SmF Br



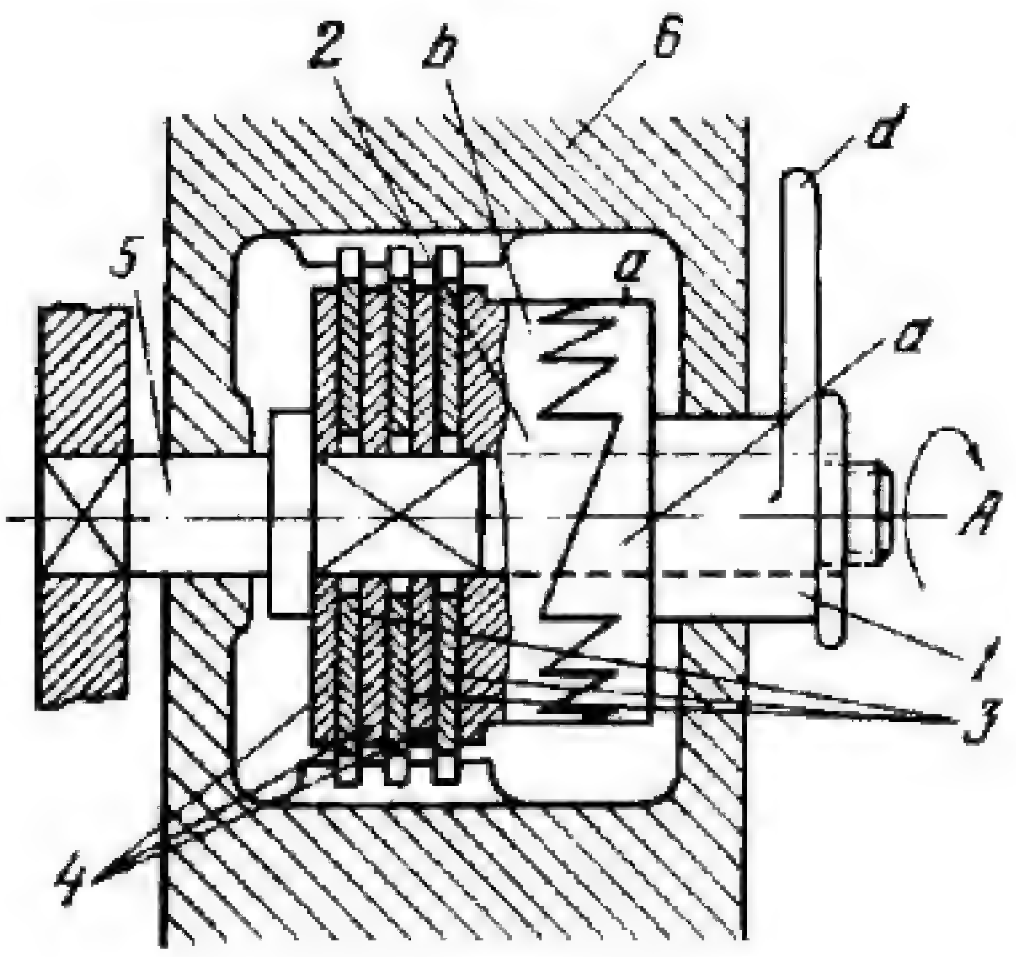
Brake disk *2* rotates about fixed axis *A* and is rigidly attached to drum *b* about which flexible link *c* is wound in hoisting load *d*. Braking cam *1* turns about fixed axis *B* and has a working surface along a circular arc described from point *O* which lies on normal *AC*. The load is hoisted by rotating the disk and drum counterclockwise. Reverse rotation of disk *2* and the drum (and dropping of the load) is prevented by cam *1* which jams disk *2* if angle γ has been properly chosen. Flat spring *3* holds cam *1* in contact with disk *2*.

3380	SELF-ACTING FRICTION SHOE BRAKE MECHANISM OF A HOISTING DRUM	SmF Br



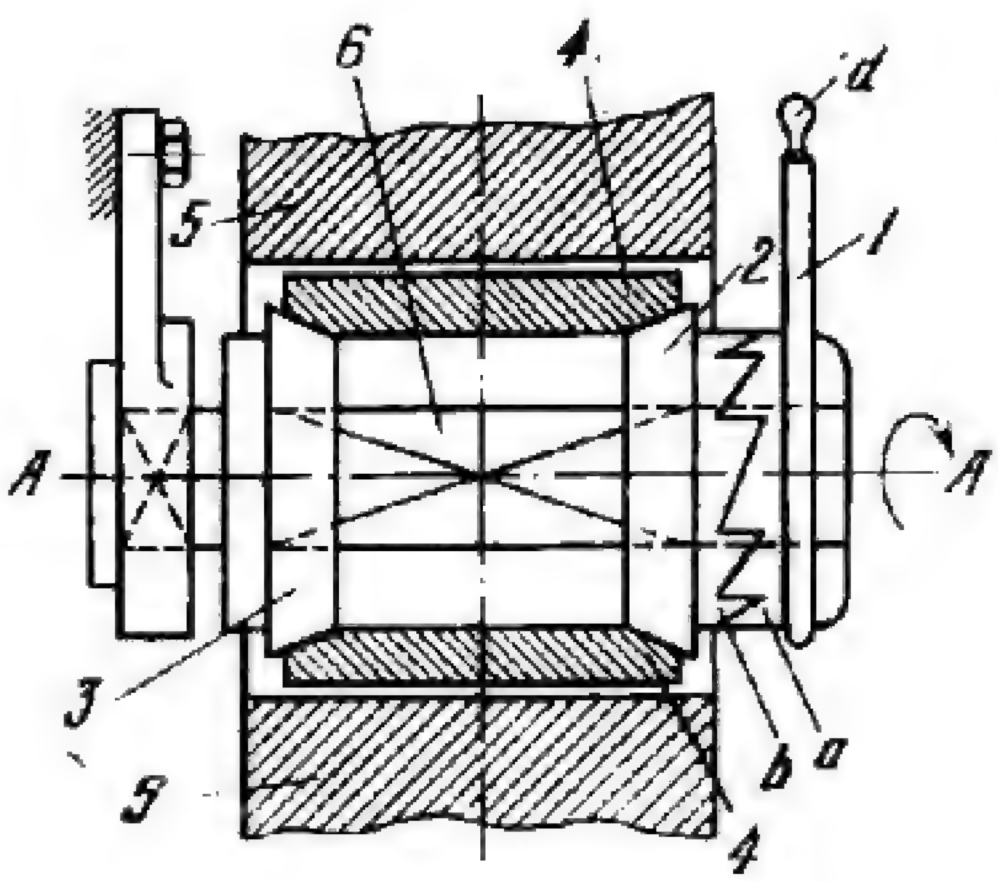
Brake disk *2* rotates about fixed axis *A* and is rigidly attached to drum *b* about which flexible link *c* is wound in hoisting load *d*. Lever *1* turns about fixed axis *B*. Shoe *3* turns about axis *D* of lever *1*. The load is hoisted by rotating the disk and drum counterclockwise. Reverse rotation of disk *2* and the drum (and dropping of the load) is prevented by the jamming of shoe *3* between disk *2* and lever *1* if angle γ is small enough. Flat spring *4* holds shoe *3* in contact with disk *2*.

3381	MULTIPLE-DISK FRICTION BRAKE MECHANISM WITH A SAW-TOOTH OPERATING DEVICE	SmF Br



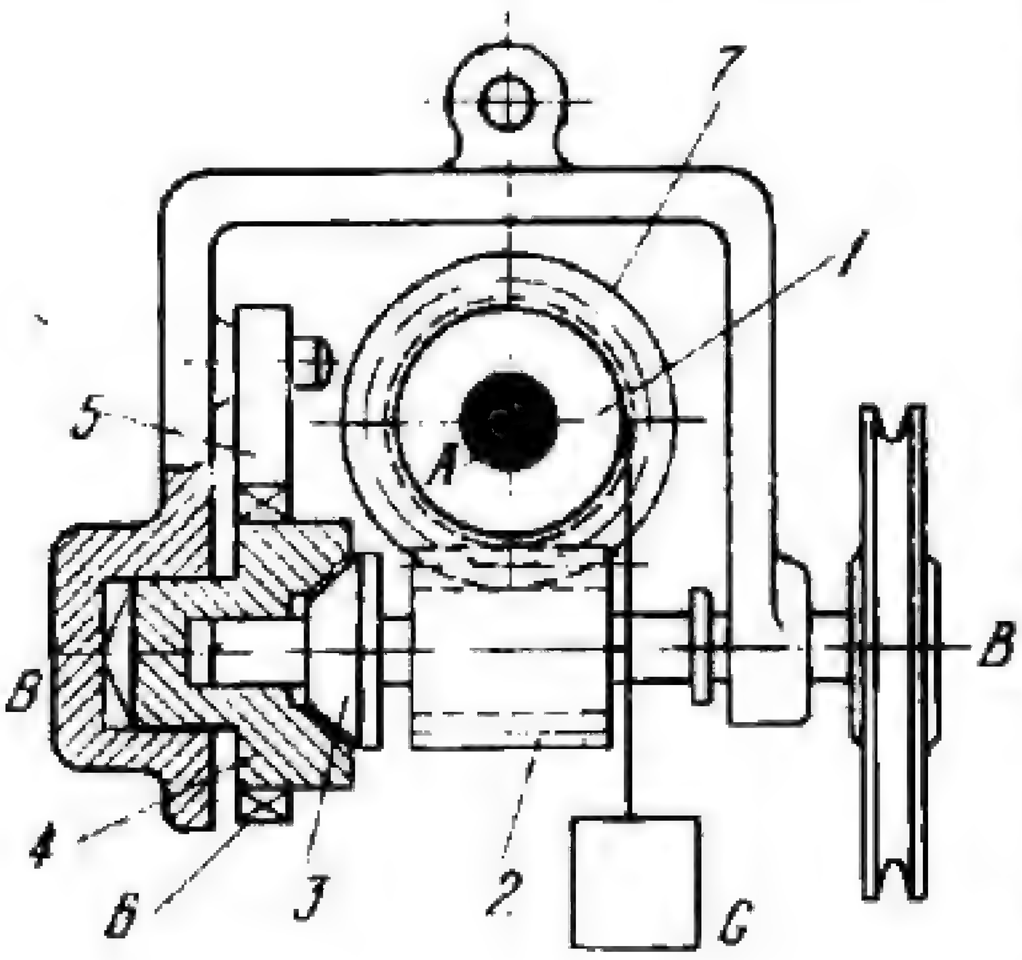
Link *1* turns about fixed axis *A* and has saw-shaped teeth *a* which engage teeth *b* of link *2*. Link *2* has only axial motion along axis *A* of fixed shaft *5*. Link *6* rotates freely about axis *A* and is keyed to rotating disks *3*. Stationary disks *4* are keyed to fixed shaft *5*. When lever *d* of link *1* is turned clockwise (looking from the right), the action of teeth *a* and *b* pushes link *2* to the left, applying pressure between the stationary and rotating disks and braking link *6*.

3382	DOUBLE-CONE FRICTION BRAKE MECHANISM WITH A SAW-TOOTH OPERATING DEVICE	SmF Br



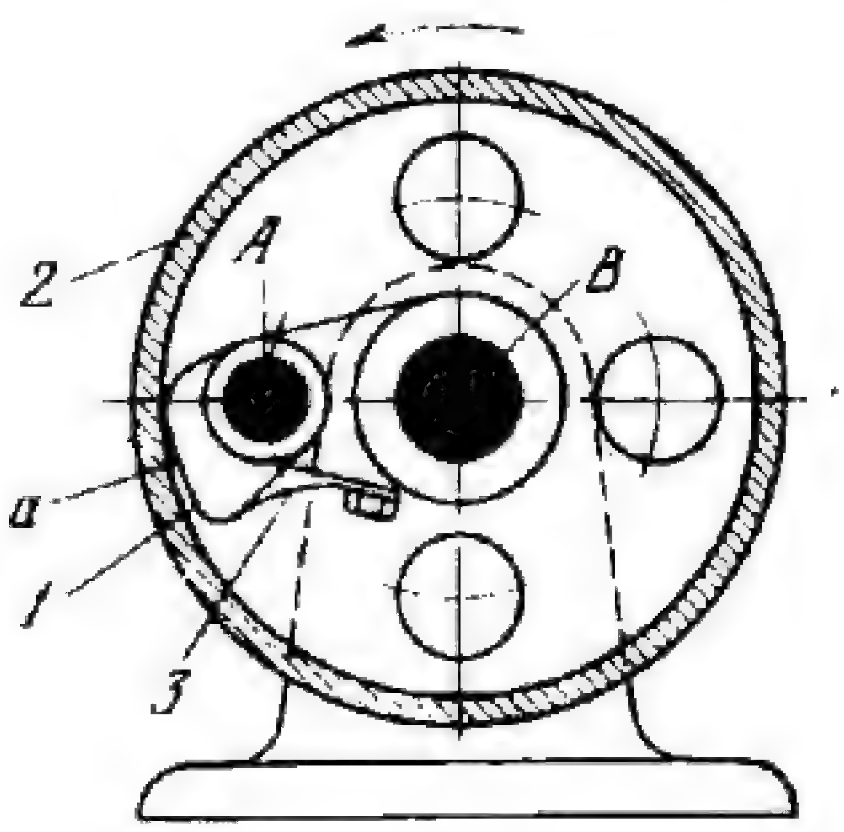
Link *1* turns about fixed axis *A-A* and has saw-shaped teeth *a* which engage teeth *b* of cone *2*. Cone *2* has only axial motion along axis *A-A* of fixed shaft *6*. Cone *3* is rigidly secured to shaft *6*. Drum *5* rotates freely about axis *A-A*. When lever *d* of link *1* is turned clockwise (looking from the right), the action of teeth *a* and *b* pushes cone *2* to the left toward cone *3*, expanding split bushing *4*. This presses bushing *4* against the bore of drum *5* and brakes the drum.

3383	SELF-ACTING CONE FRICTION BRAKE MECHANISM OF A HOISTING SHEAVE	SmF Br



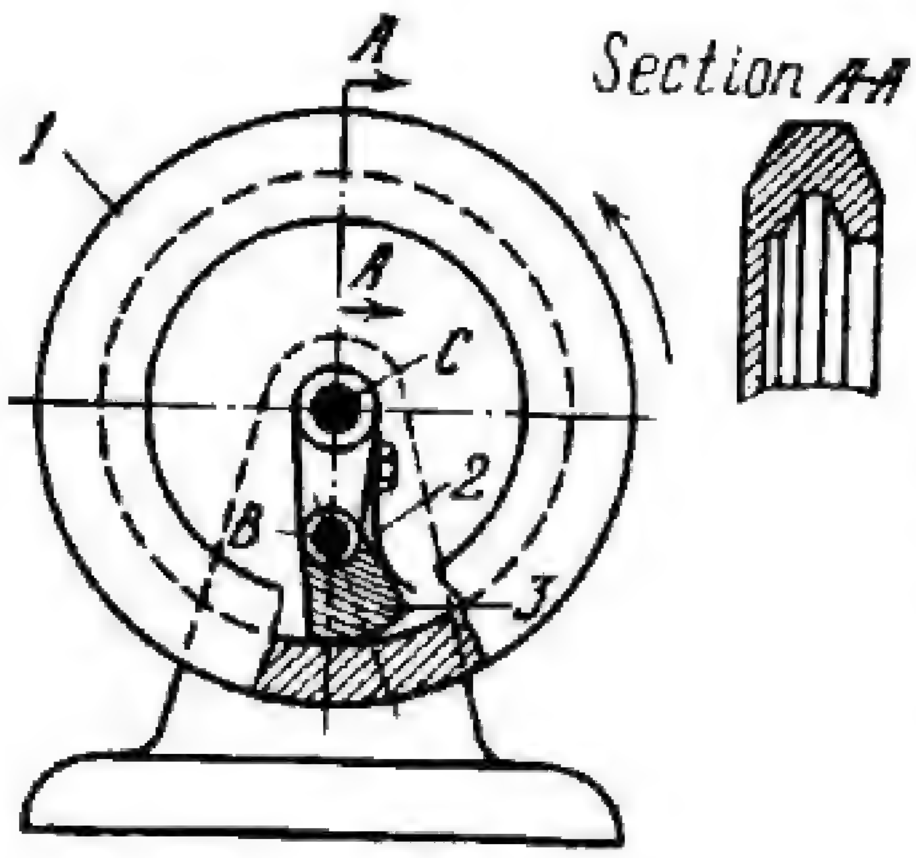
Worm wheel *7* rotates about fixed axis *A* and is rigidly attached to sheave *1* over which a flexible link runs in hoisting load *G*. Worm *2*, meshing with worm wheel *7*, is rigidly attached to cone *3*, and rotates about and has axial motion along fixed axis *B-B*. Load *G* applies a clockwise torque to sheave *1* and worm wheel *7* which pushes worm *2* to the left, forcing cone *3* into conical cup *4*. This applies the brake because cup *4* is held against rotation by ratchet wheel *6*, integral with the cup, and pawl *5*. When the load is raised, pawl *5* slides over the teeth of ratchet wheel *6*.

3384	SELF-ACTING FRICTION CAM BRAKE MECHANISM	SmF Br



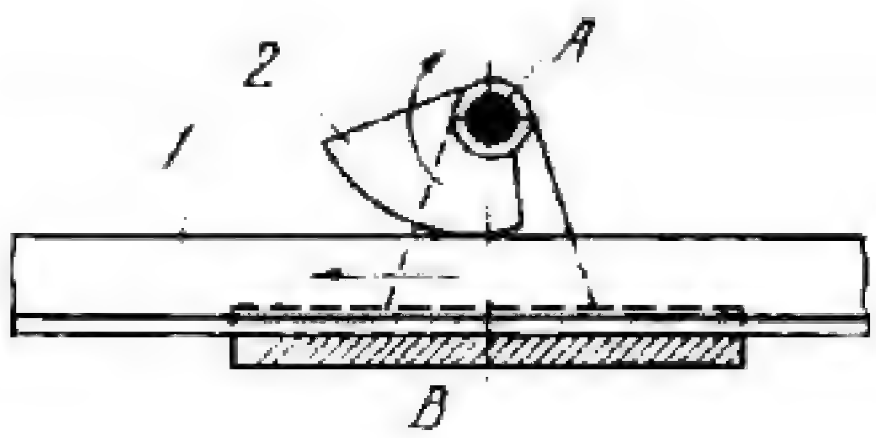
Drum *2* rotates about fixed axis *B*. Cam *1* turns about fixed axis *A* and its working surface *a* is designed so that the cam is jammed between its axis and the rim of drum *2*, braking the drum when it starts to rotate clockwise. When the drum rotates counterclockwise, its rim slides freely along surface *a* of cam *1*. Cam *1* is held in contact with drum *2* by flat spring *3*.

3385 | **SELF-ACTING WEDGE-SURFACE FRICTION BRAKE MECHANISM** | SmF Br



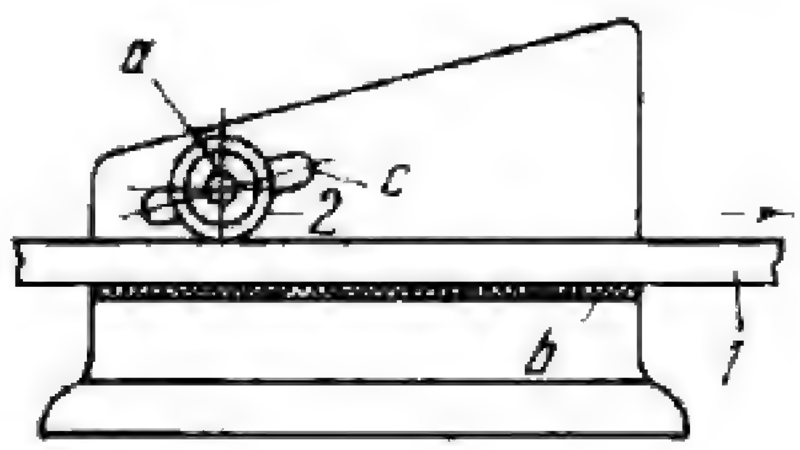
Brake disk *1* rotates about fixed axis *C* and has a wedge-shaped internal groove which is engaged by wedged braking shoe *3*. Shoe *3* turns about fixed axis *B*. Disk *1* rotates freely counterclockwise. When it starts to rotate clockwise, it is braked by the jamming of the shoe in the groove of the disk. Shoe *3* is held in contact with the groove of disk *1* by flat spring *2*.

3386 | **SELF-ACTING FRICTION BRAKE MECHANISM FOR A SLIDE** | SmF Br



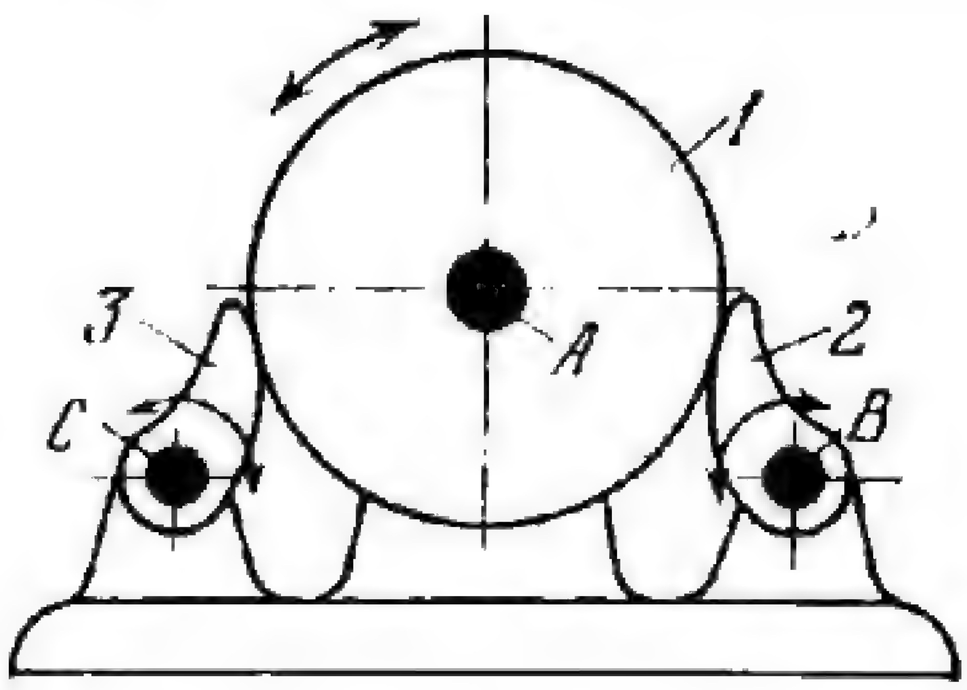
Slide *1* moves along fixed guide *B* to the left. Brake shoe *2* turns about fixed axis *A* and has a working surface designed to jam the shoe when slide *1* starts to move to the right.

3387 | **SELF-ACTING FRICTION BRAKE MECHANISM FOR A SLIDE** | SmF Br



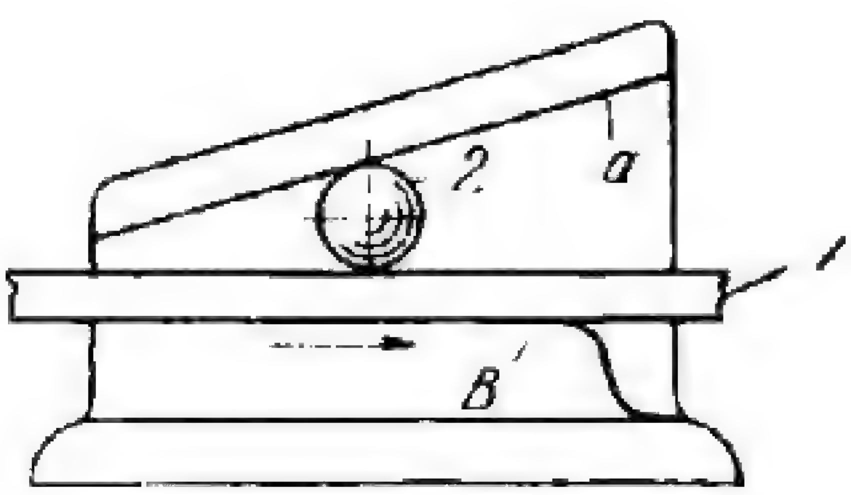
Slide *1* moves along fixed guide *b* to the right. Roller *2* turns about pin *a* which slides along fixed inclined slot *c*. When slide *1* starts to move to the left, roller *2*, in contact with the slide, becomes jammed and brakes the slide.

3388	SELF-ACTING DOUBLE-SHOE FRICTION BRAKE MECHANISM	SmF Br



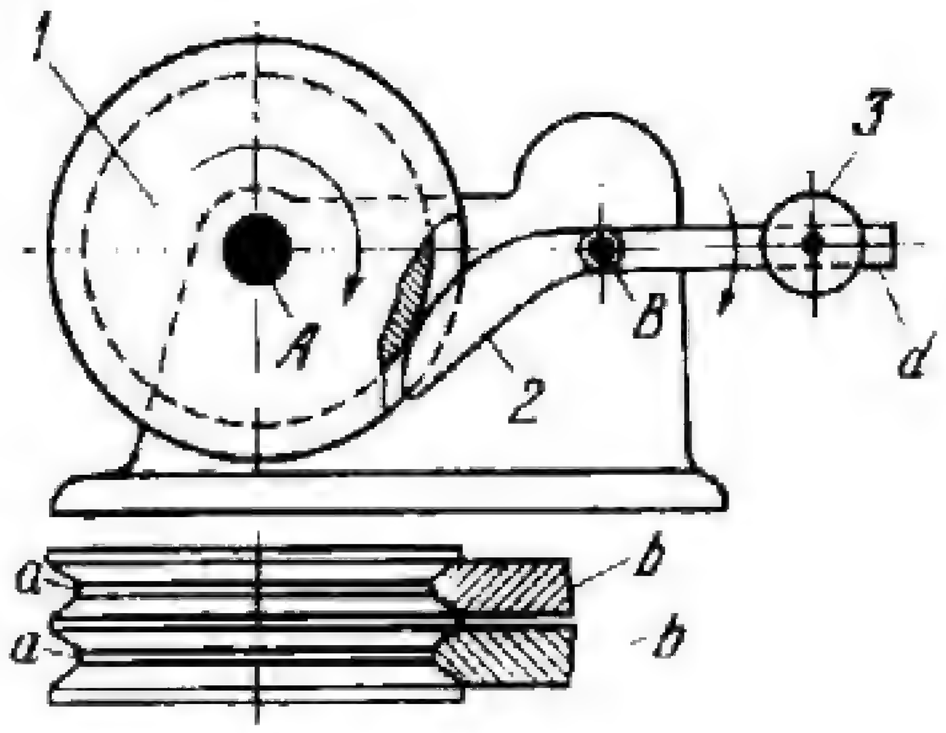
Disk *1* rotates about fixed axis *A*. Brake shoes *2* and *3* turn about fixed axes *B* and *C*. The working surfaces of shoes *2* and *3* are designed so that each shoe allows rotation of disk *1* in one direction and jams to stop rotation in the other direction. Thus disk *1* can rotate in either one or the other direction depending on which shoe, *2* or *3*, is in contact with the disk. Shoe *2* allows counterclockwise rotation of disk *1*, and shoe *3*, clockwise rotation.

3389	SELF-ACTING BALL-TYPE FRICTION BRAKE MECHANISM	SmF Br



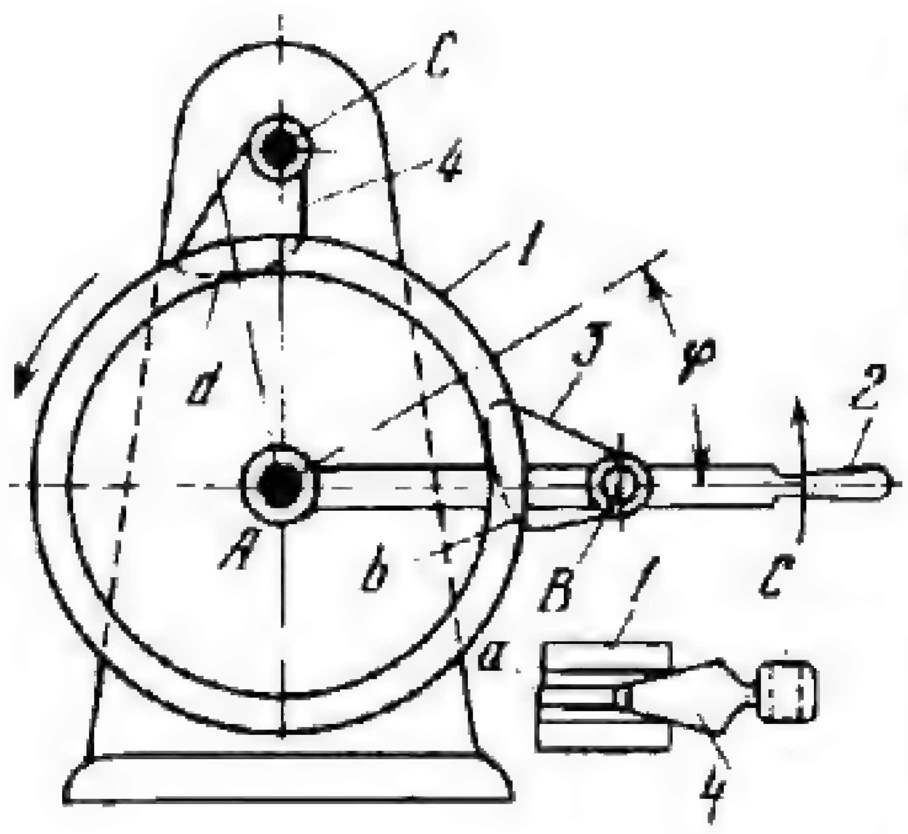
Slide *1* moves along fixed guide *B* to the right. Ball *2* is between inclined surface *a* and slide *1*. When slide *1* starts to move to the left, ball *2* is jammed between surface *a* and the slide which it brakes.

3390 SELF-ACTING WEDGE-SURFACE FRICTION BRAKE MECHANISM — SmF Br



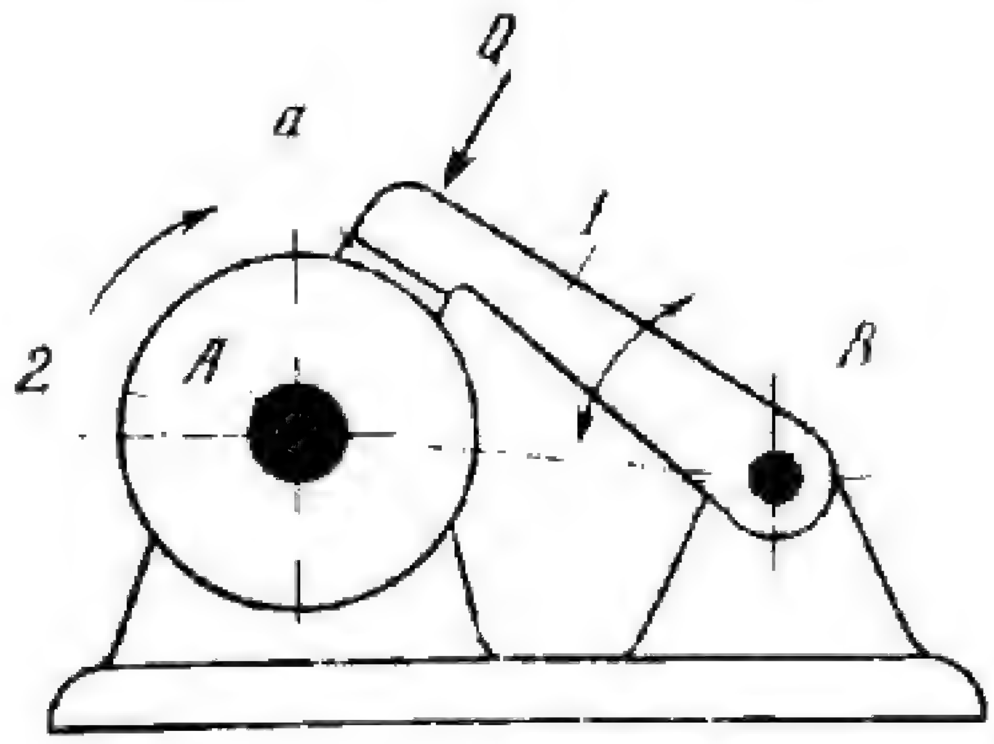
Brake drum *1* rotates about fixed axis *A* and has two wedge-shaped grooves *a* which are engaged by two wedged ridges *b* of lever *2*. Lever *2* turns about fixed axis *B* and carries weight *3* which can be adjusted along guide *d* and clamped in the required position. Weight *3* presses ridges *b* of lever *2* into grooves *a* to brake drum *1*.

3391 FRICTION RATCHET FEEDING MECHANISM — SmF Br



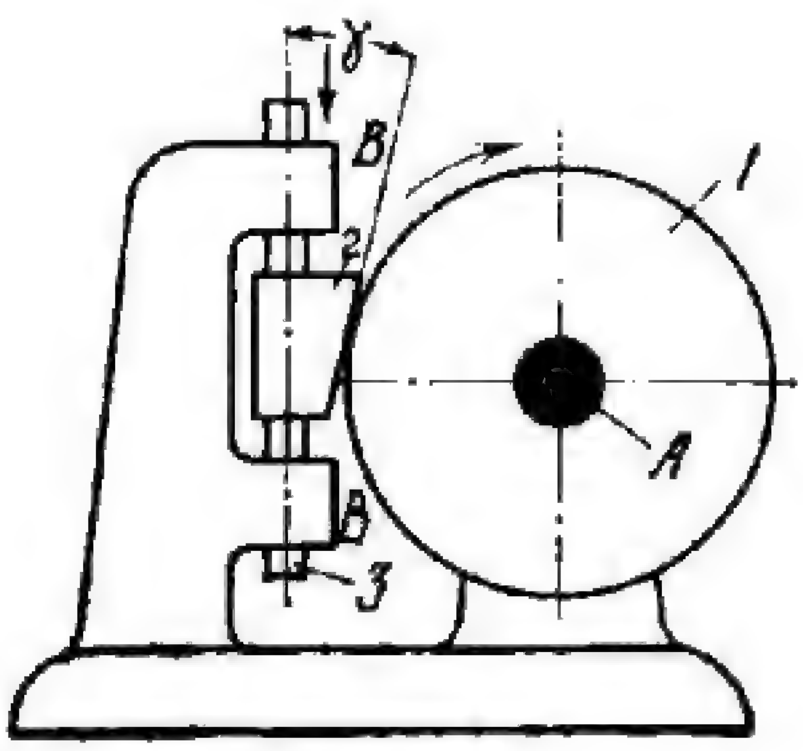
Disk *1* rotates about fixed axis *A* and has wedge-shaped groove *a* which is engaged by wedged segment *3*. Segment *3* turns about axis *B* of lever *2* which turns freely about axis *A*. Working surface *b* of segment *3* is designed so that the segment jams in groove *a* when lever *2* is turned counterclockwise, and turns disk *1* in the same direction through the angle φ required for the feed movement. When lever *2* is returned to its initial position, segment *3* slides along groove *a* and clockwise rotation of disk *1* is prevented by segment *4* which turns about fixed axis *C* and has working surface *d* that jams in groove *a*.

3392	LEVER-TYPE FRICTION STOP	SmF SD



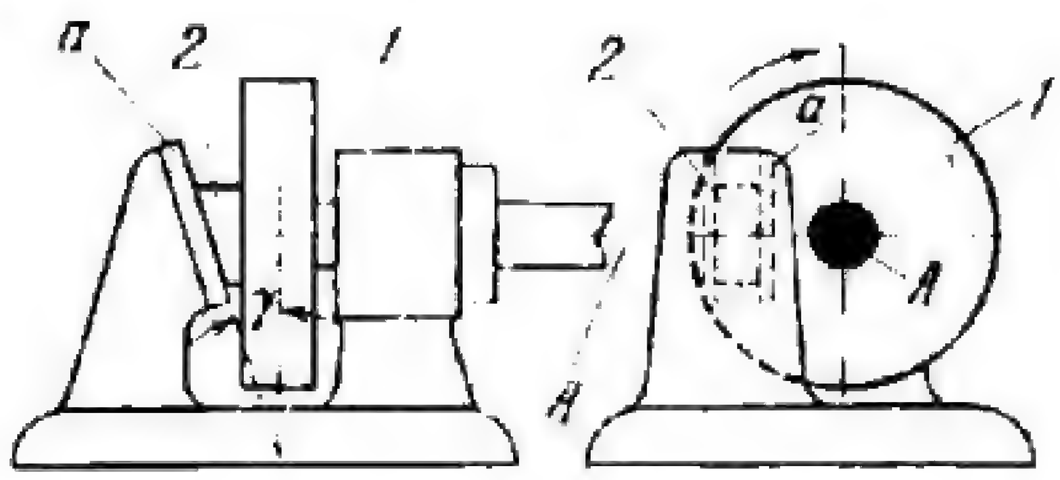
Disk *2* rotates about fixed axis *A*. Lever *1* turns about fixed axis *B* and carries shoe *a*. When force *Q* acts on lever *1*, shoe *a* is pressed against disk *2*, locking it against rotation in either direction.

3393	WEDGE-TYPE FRICTION STOP	SmF SD



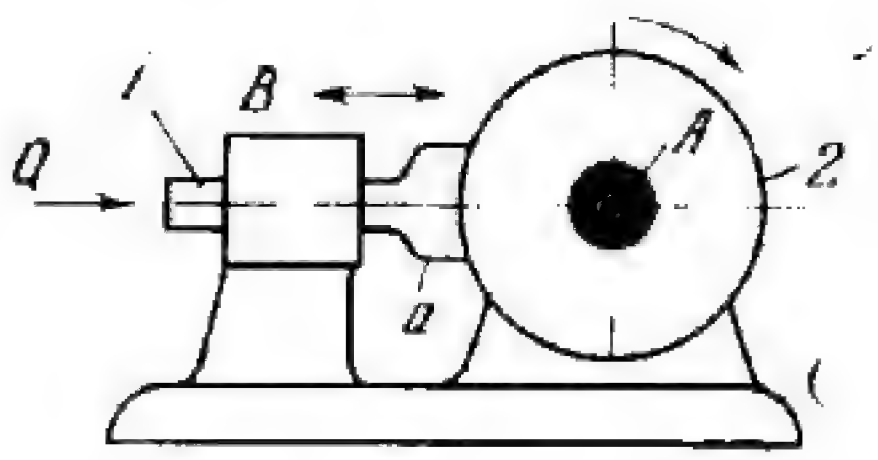
Disk *1* rotates about fixed axis *A*. Prismatic link *3* slides vertically in guides *B-B* and carries flat wedge *2* which engages disk *1*. Disk *1* rotates freely clockwise. Counterclockwise rotation is prevented by wedge *2* which jams and stops disk *1* if angle γ has been properly chosen.

3394	WEDGE-TYPE SPATIAL FRICTION STOP	SmF SD



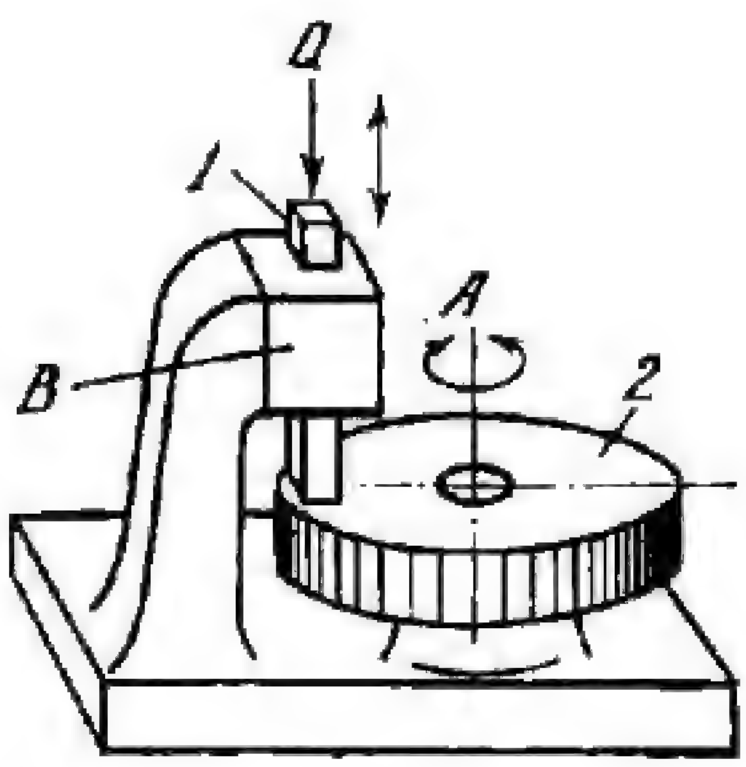
Disk *1* rotates about fixed axis *A*. Wedge *2* slides along fixed guide *a* and engages the end face of disk *1*. Disk *1* can only rotate clockwise. Counterclockwise rotation is prevented by wedge *2* which jams and stops disk *1* if angle γ has been properly chosen.

3395	PLUNGER-TYPE FRICTION STOP	SmF SD



Disk *2* rotates about fixed axis *A*. Plunger *1* slides in fixed guide *B* and carries shoe *a*. When force *Q* acts on plunger *1*, shoe *a* is pressed against disk *2*, locking it against rotation in either direction.

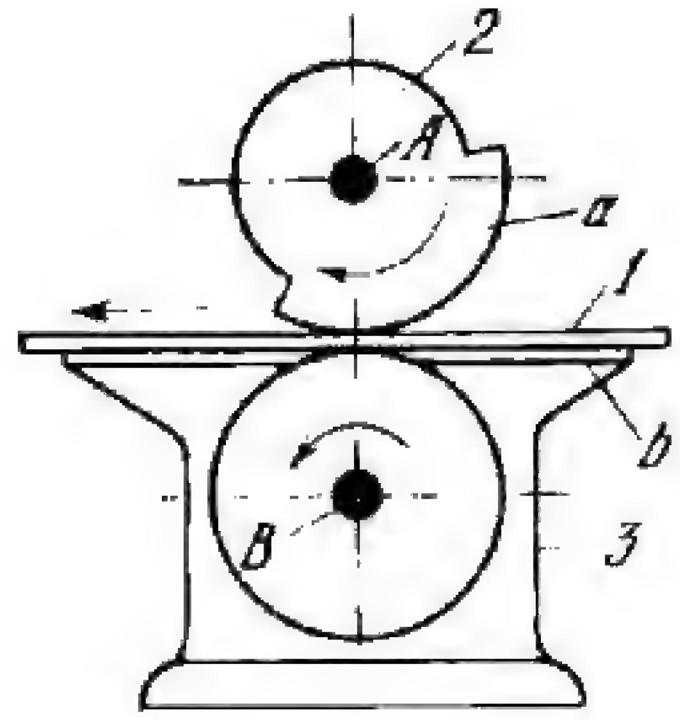
3396	PLUNGER-TYPE SPATIAL FRICTION STOP	SmF SD



Disk *2* rotates about fixed axis *A*. Plunger *1* slides in fixed guide *B*. When force *Q* acts on plunger *1*, the end of the plunger is pressed against the face of disk *2*, locking it against rotation in either direction.

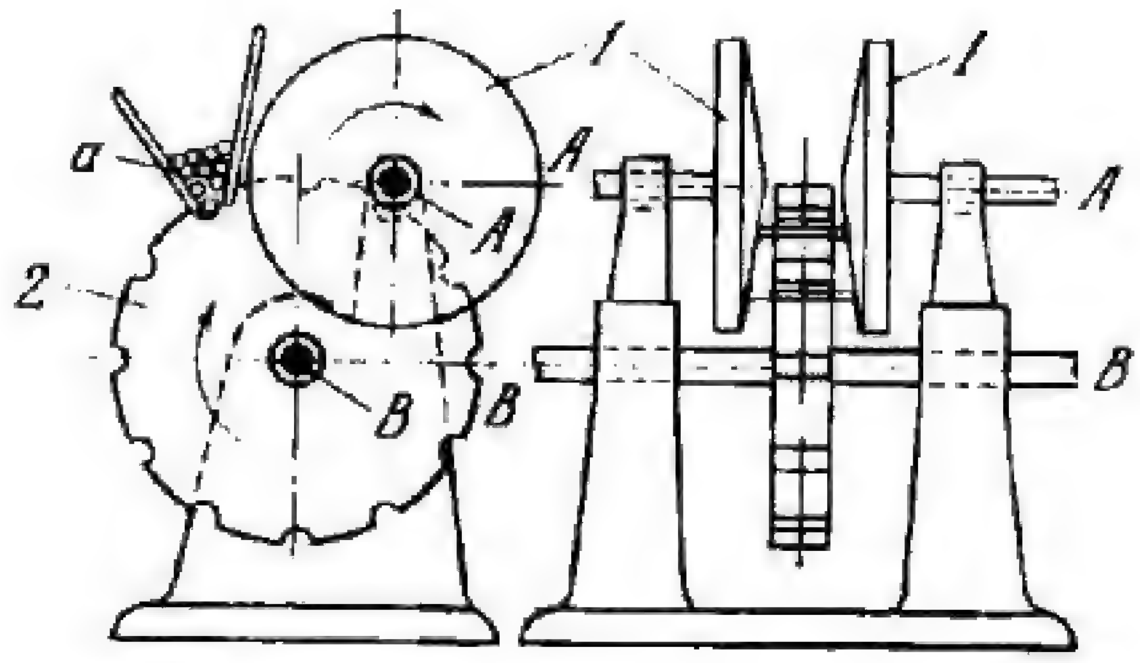
5. SORTING AND FEEDING MECHANISMS
(3397 through 3400)

3397	FRICTION-TYPE STRIP FEED MECHANISM	SmF SF



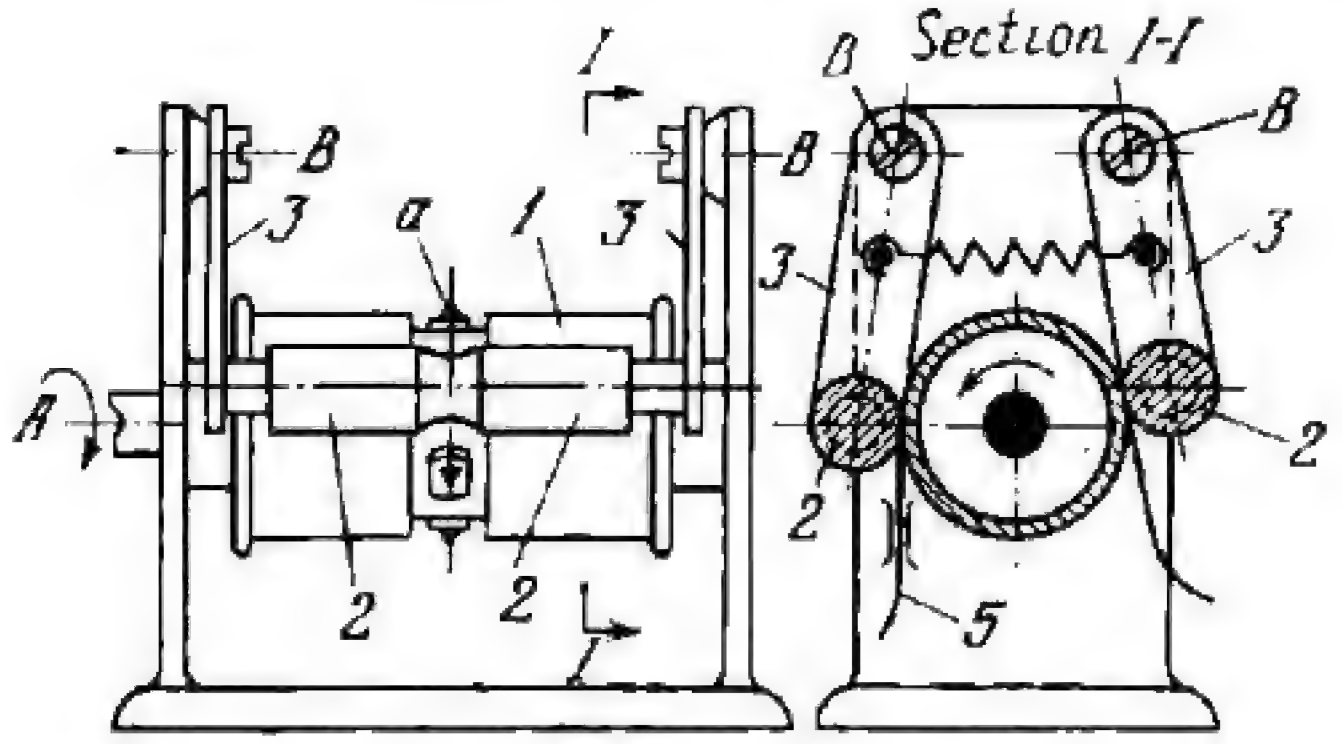
Segment friction wheel *2* rotates about fixed axis *A*. Strip *1* slides along fixed guide *b*. The strip is fed intermittently when it is in contact with lobe *a* of wheel *2*. Strip *1* imparts rotation to wheel *3* about fixed axis *B*. This facilitates the feed motion of the strip.

3398	FRICTION-TYPE NEEDLE ROLLER SORTING MECHANISM	SmF SF



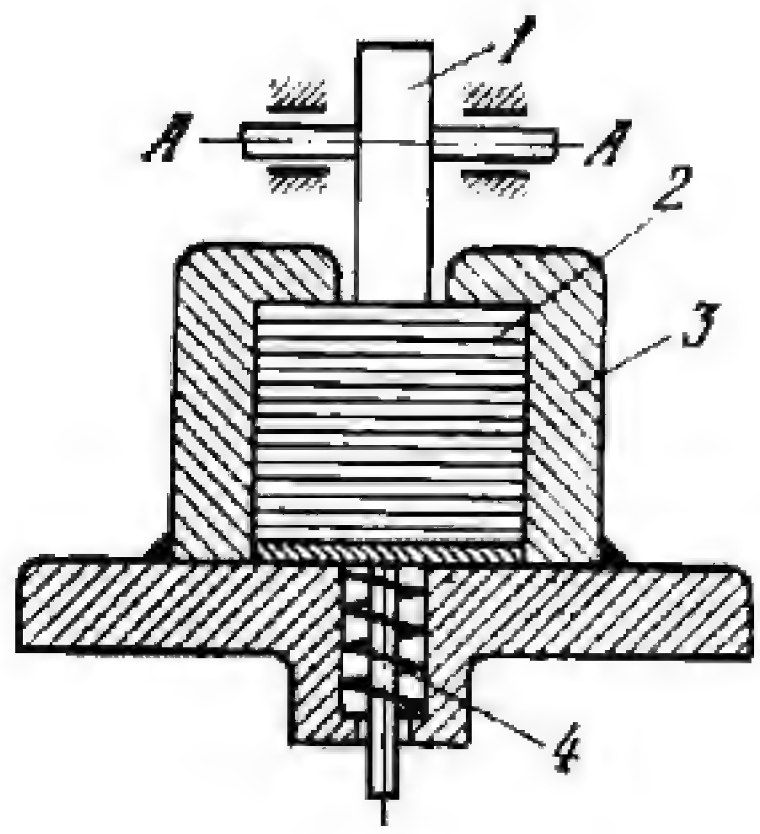
The mechanism sorts needle rollers for bearings according to their length and consists of two cones *1*, facing each other and rotating about fixed axes *A* at the same speed. Needle rollers *a* are fed in by feeding disk *2* which rotates about fixed axis *B-B*. Depending upon their length the needle rollers are gripped between cones *1* at various radii and are carried over to a set of chutes into which they drop. All the rollers in a length group drop into the same chute.

3399	FRICTION-TYPE RECORD PAPER FEEDING MECHANISM OF AN OSCILLOGRAPH	SmF SF



Drum *1* rotates about fixed axis *A*. Links *3* turns about fixed axes *B* and carry rollers *2*. When drum *1* rotates, light-sensitive paper *5*, pressed to the drum by rollers *2*, is advanced. To ensure accurate feeding of the paper, pins *a* are provided on drum *1* with corresponding grooves in rollers *2*.

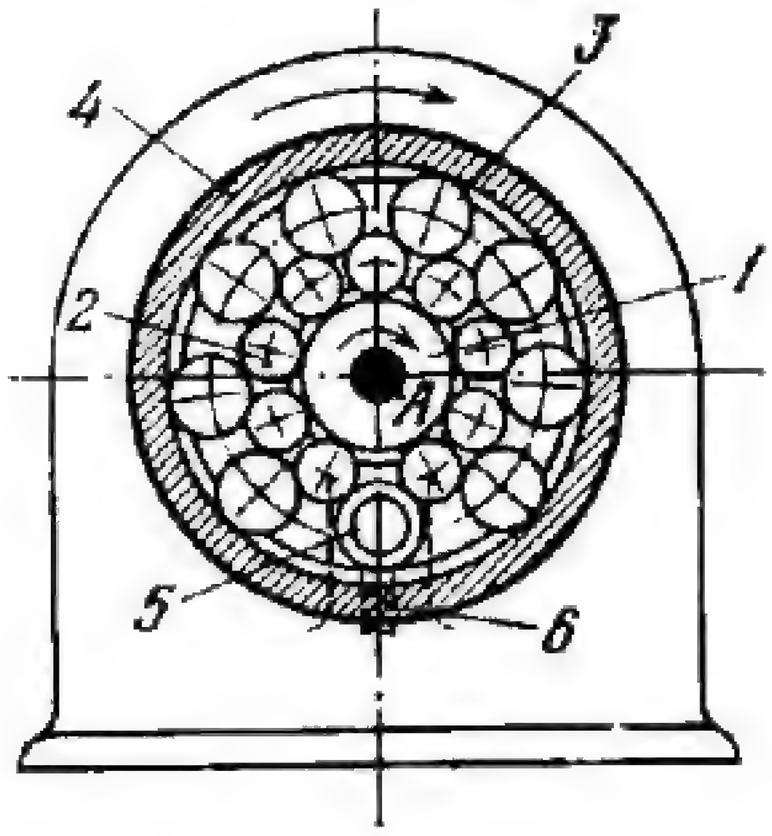
3400	FRICTION-TYPE PLATE FEEDING MECHANISM	SmF SF



Eccentric *1*, of rubber or another elastic material, rotates about fixed axis *A-A* and is connected to the crankshaft of a press. When eccentric *1* rotates, plate blanks *2* are pushed, one by one out of magazine *3* through a slit controlled by a shield (not shown). The plates are held against the top of the magazine by spring *4*.

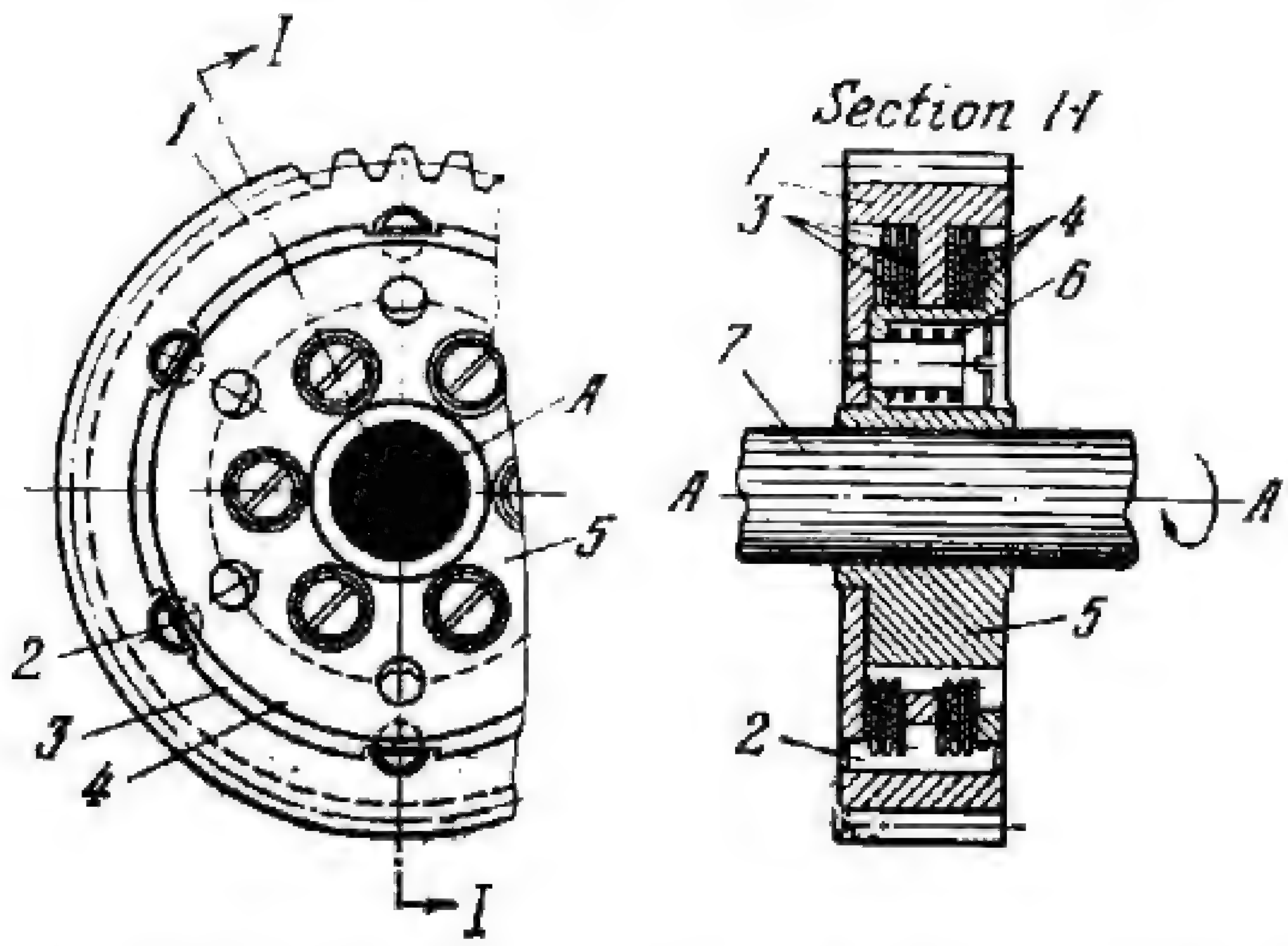
6. CLUTCH AND COUPLING MECHANISMS
(3401 through 3412)

3401	FRICTION-TYPE MECHANISM OF A ROLLER COUPLING	SmF C



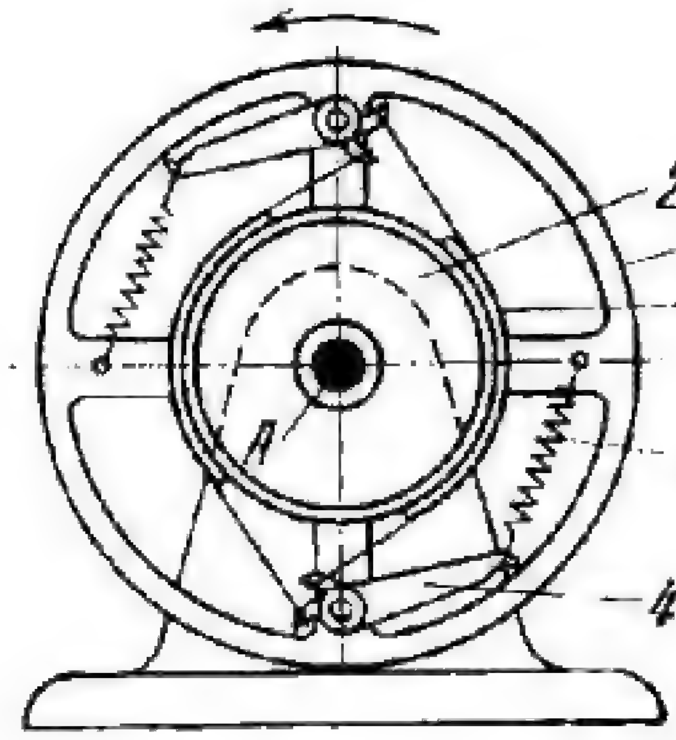
Friction wheel *1* and driven link *4* rotate about fixed axis *A*. Rotation is transmitted from wheel *1* to link *4* through two rows of rollers, *2* and *3*. The pressure required for transmitting motion is developed by spring *6* which acts on the stud of roller *5* and through this roller on all the other rollers.

3402	FRICTION-TYPE OVERLOAD CLUTCH MECHANISM	SmF C



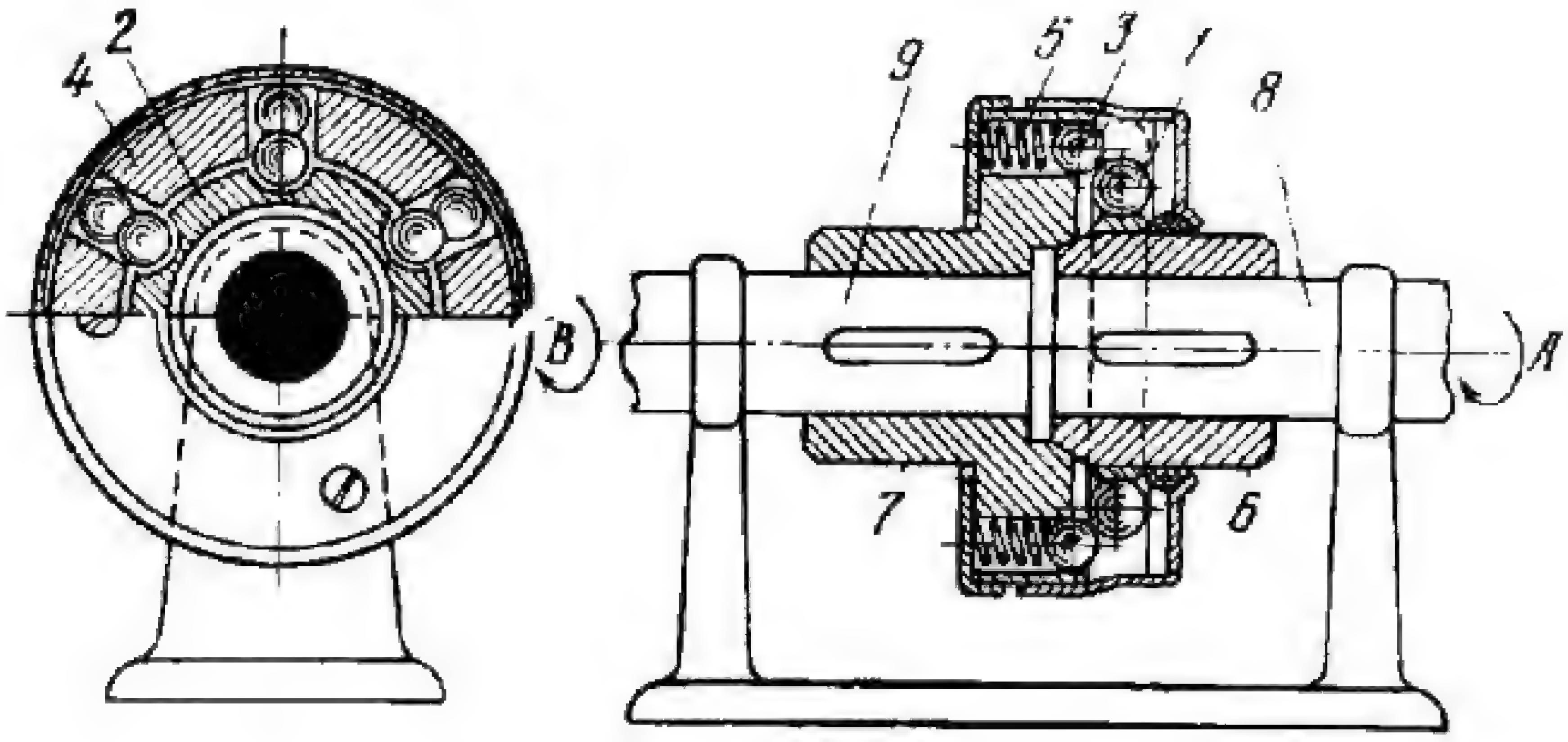
Rotation is transmitted from gear *1* to shaft *7*, rotating about fixed axis *A-A*, by pins *2*, disks *3* and *4*, and hub *5* which is keyed to shaft *7*. Pins *2* engage notches in friction disks *3*. Friction disks *4* have lugs which engage corresponding notches in hub *5*. The torque transmitted by the clutch is proportional to the total axial pressure applied on the clutch disks by springs *6*. Upon overload, disks *3* and *4* slide with respect to one another and shaft *7* stops.

3403	IMPACT-PROOF FLEXIBLE FRICTION COUPLING MECHANISM	SmF C



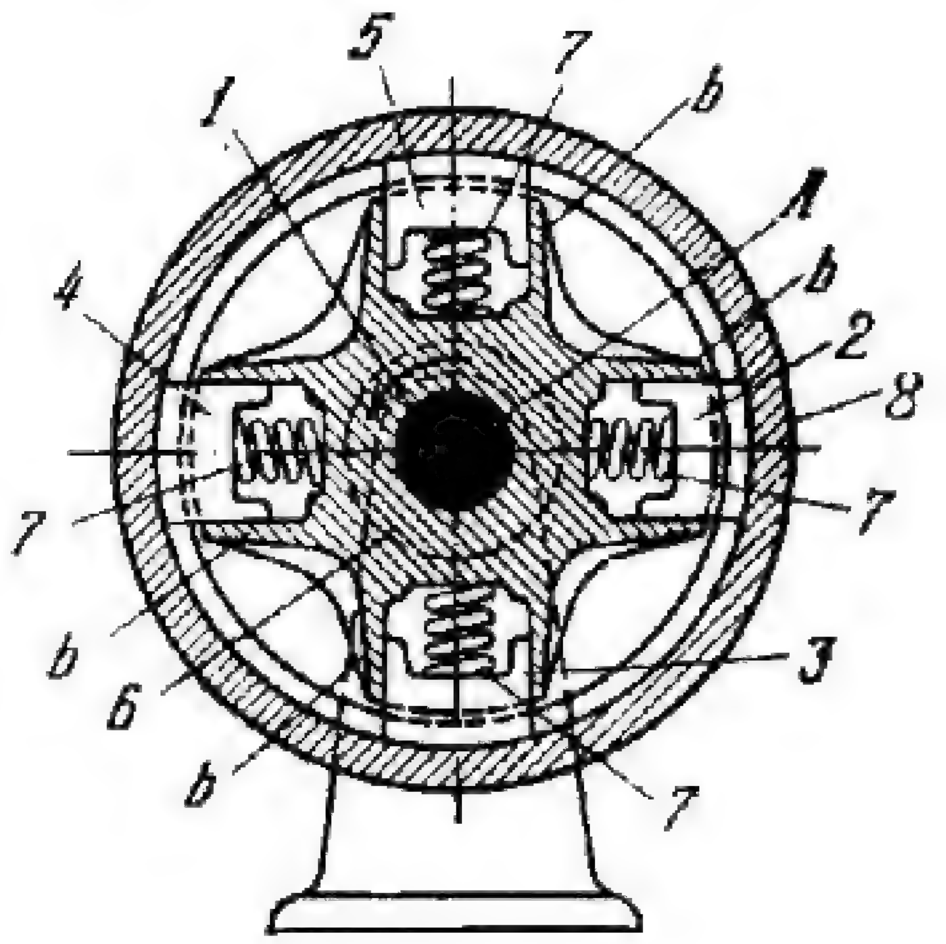
Counterclockwise rotation of driving wheel *1* about fixed axis *A* is transmitted to driven disk *2* by friction which is developed by steel bands *a*. The bands are held tightly against disk *2* by springs *3* acting through levers *4*. Upon a sudden change in the speed of the driving wheel, the steel bands slip on disk *2*, reducing the impact transmitted to the disk.

3404	FRICTION-TYPE OVERLOAD BALL CLUTCH MECHANISM	SmF C



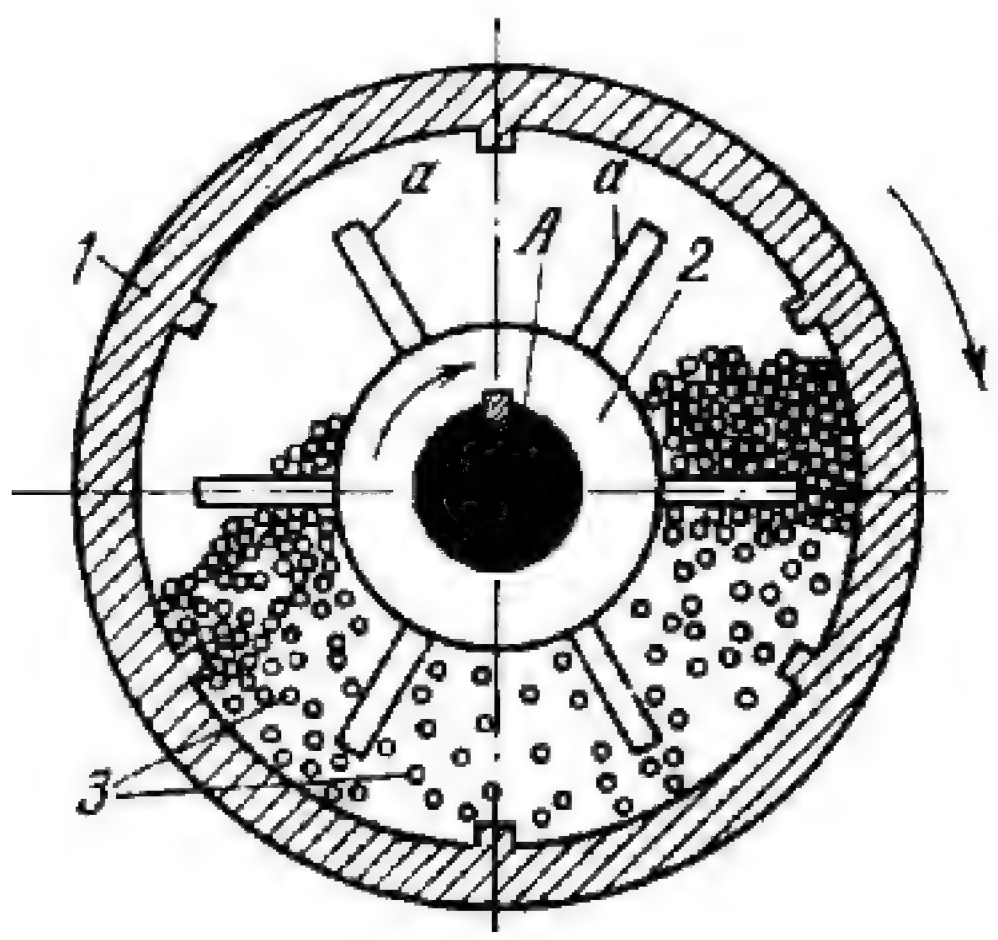
Right-hand member *6* of the clutch is keyed to shaft *8* and rotates about fixed axis *A*. Left-hand member *7* of the clutch is keyed to shaft *9* and rotates about fixed axis *B*. Torque up to the permissible value is transmitted from shaft *8* to shaft *9* through balls *1*, located in recesses of ring *2*, and balls *3* in the holes of disk *4*. Upon overload, balls *1* are raised to the position shown by dash lines, and the clutch is disengaged. When the torque is reduced again, springs *5* push balls *3* and *1* back to their initial positions and the clutch is engaged again.

3405	SELF-DISENGAGING FRICTION-TYPE CLUTCH MECHANISM	SmF C



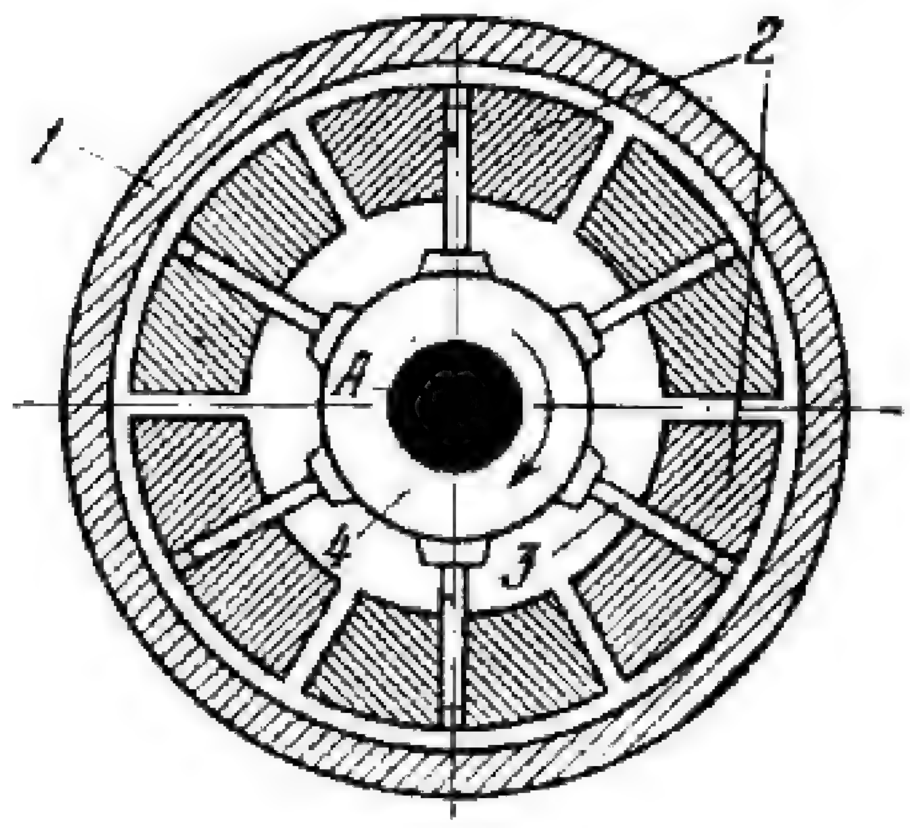
Cross-shaped member *6* is keyed to shaft *1*, rotates about fixed axis *A* and has symmetrically located guides *b* in which brake shoes *2*, *3*, *4* and *5* slide. The brake shoes are connected by springs *7* to member *6*. Driven link *8* rotates about axis *A*. As the speed of driving shaft *1* increases, the centrifugal forces of inertia of shoes *2*, *3*, *4* and *5* increase and the shoes are pressed against the rim of link *8*, thereby increasing the transmitted torque. When the speed of shaft *1* is reduced, the centrifugal forces of the shoes are decreased and springs *7* disengage the clutch.

3406	CENTRIFUGAL FREE-BALL FRICTION CLUTCH MECHANISM	SmF C



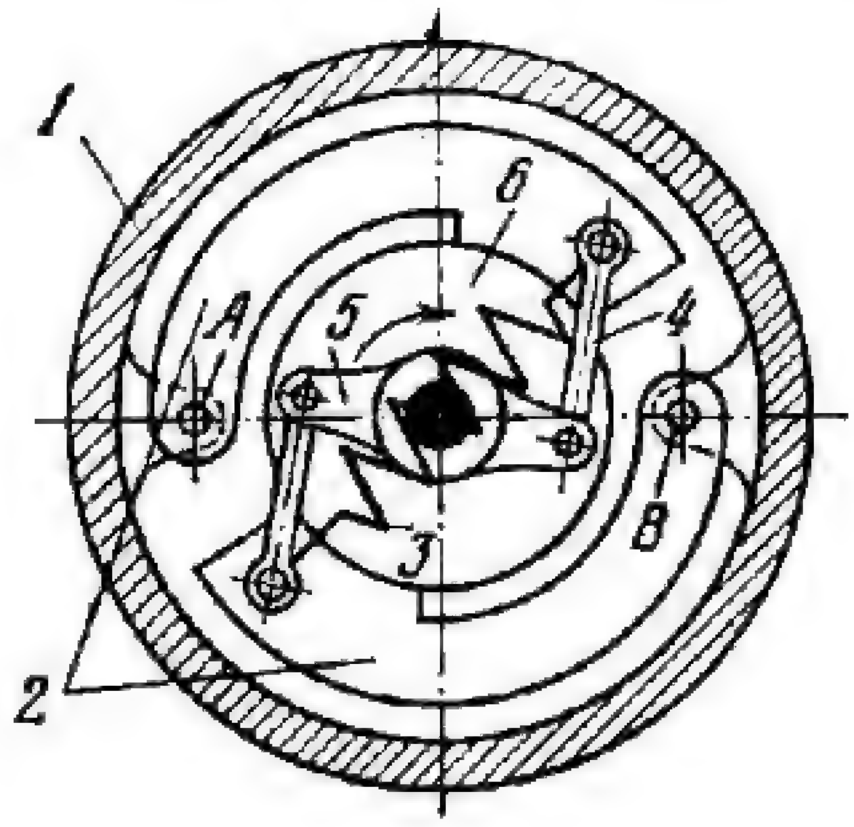
Keyed to the driving shaft is hub *2* with radial vanes *a*. Drum *1* is keyed to the driven shaft and is filled to some extent with steel balls *3*. Hub *2* and drum *1* rotate about fixed axis *A*. When the driving shaft rotates, balls *3* are held by inertia in an annular layer inside the drum which they rotate by friction. Lugs are provided on the inside surface of the drum to increase the frictional effect.

3407	CENTRIFUGAL FREE-WEIGHT FRICTION CLUTCH MECHANISM	SmF C



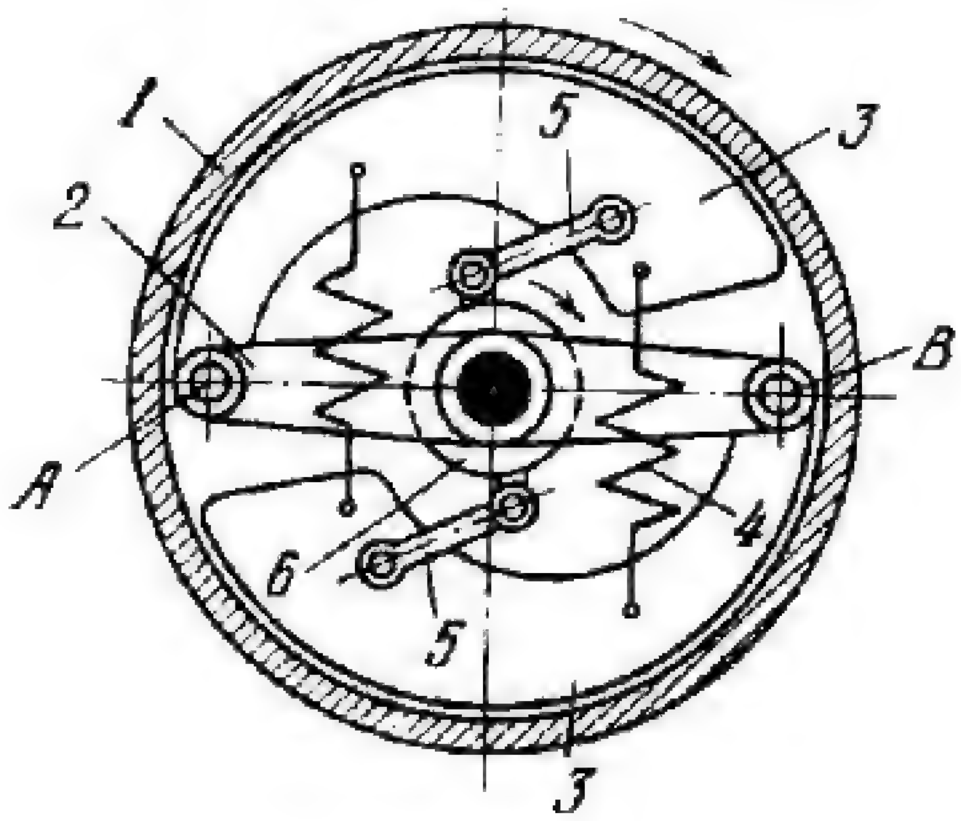
Drum *1* is keyed to the driven shaft and rotates about fixed axis *A*. Spider *4* with pins *3* is keyed to the driving shaft and rotates about axis *A*. Weights *2* slide freely along pins *3* of spider *4*. When the driving shaft reaches a definite speed, weights *2* are pressed against the drum by centrifugal force and rotate the driven shaft.

3408	SELF-DISENGAGING CENTRIFUGAL FRICTION CLUTCH MECHANISM	SmF C



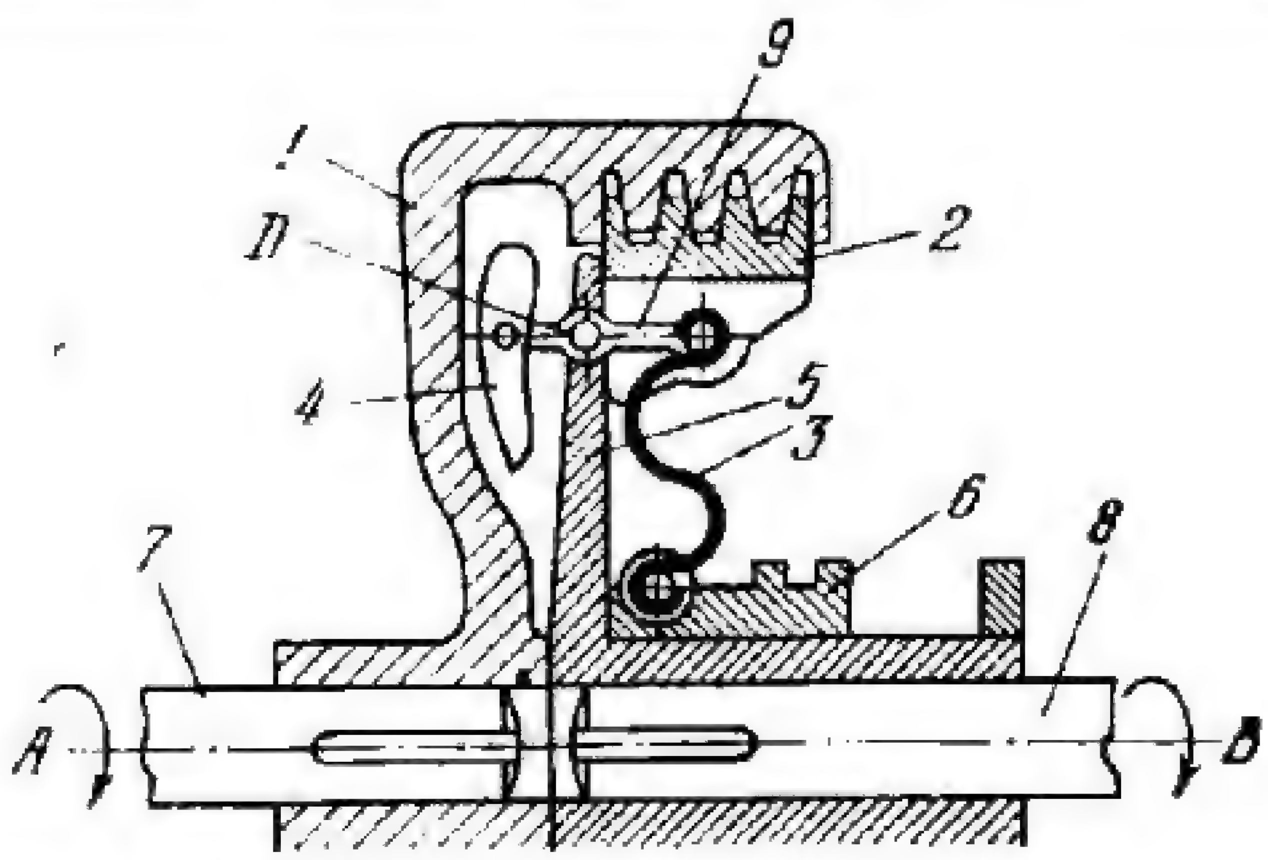
Rim *1* is keyed to the driving shaft and carries weights *2* which turn about axes *A* and *B* of the rim. Weights *2* are pressed by spring *3* against drum *6* which is keyed to the driven shaft. When the driving shaft reaches a definite speed, the clutch is disengaged because the weights develop a centrifugal force exceeding the tension of spring *3*. Levers *4*, which limit the outward motion of the weights, are pivoted to the weights and to arm *5*, rotating freely about the shaft.

3409	SELF-ENGAGING CENTRIFUGAL FRICTION CLUTCH MECHANISM	SmF C



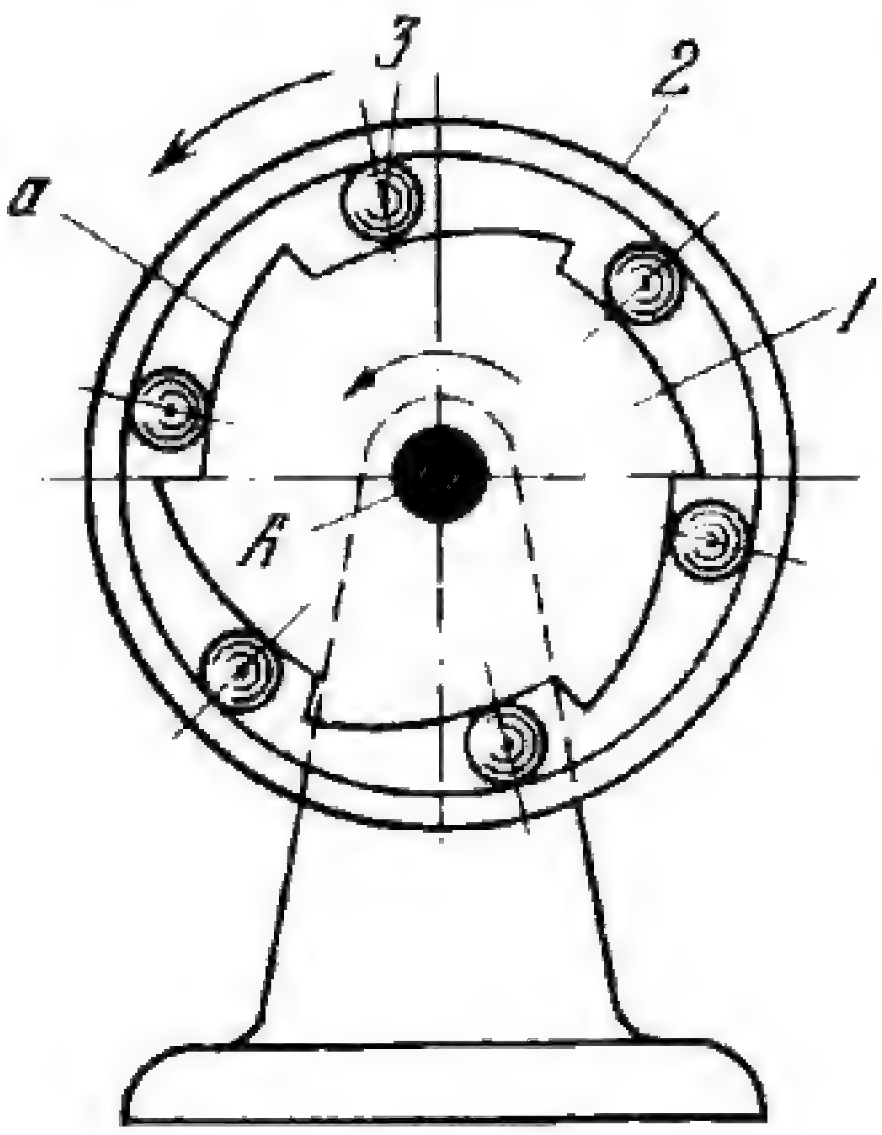
Equal weights *3* turn about axes *A* and *B* of arm *2* which is keyed to the driving shaft. Drum *1* of the clutch is keyed to the driven shaft. With an increase of the speed of the driving shaft, weights *3* are pressed by centrifugal force, overcoming the resistance of springs *4*, against the inside surface of drum *1*, thereby engaging the clutch. Levers *5*, which limit the outward motion of the weights, are pivoted to the weights and to collar *6*, rotating freely on the shaft.

3410	FRICTION CLUTCH MECHANISM WITH COUNTERBALANCING WEIGHTS	SmF C



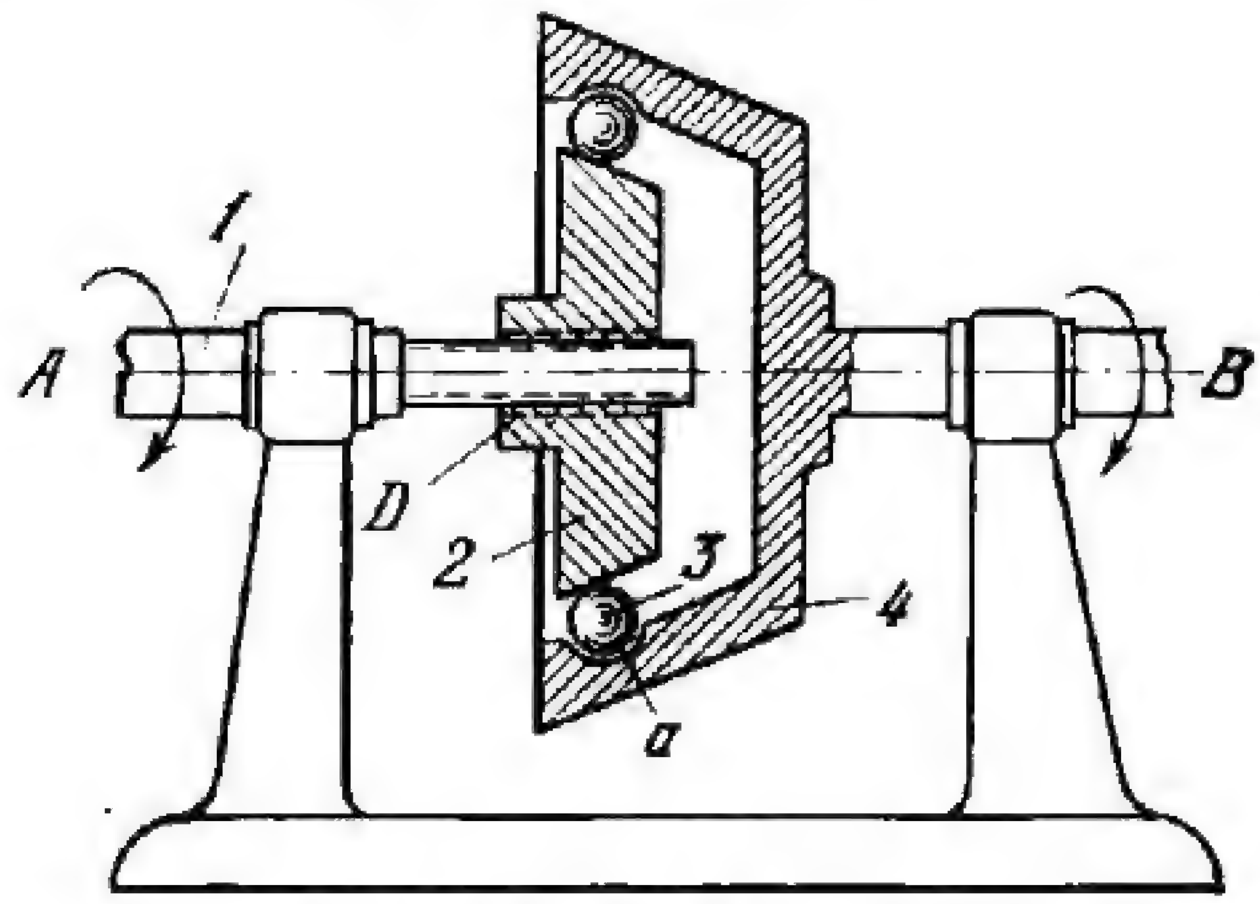
Clutch housing *1* is keyed to shaft *7* and rotates about fixed axis *A*. Springs *3* tend to press friction shoes *2* against the inside surface of housing *1*. Counterweights *4* balance the moment of the inertia forces of the shoes with respect to axes *D*. Cross-shaped link *5* is keyed to shaft *8*, rotates about fixed axis *B*, and is connected by turning pairs *D* to levers *9* to which counterweights *4* and shoes *2* are pivoted. To disengage the clutch, sleeve *6* is shifted to the right along link *5*.

3411	OVERRUNNING FRICTION CLUTCH MECHANISM	SmF C



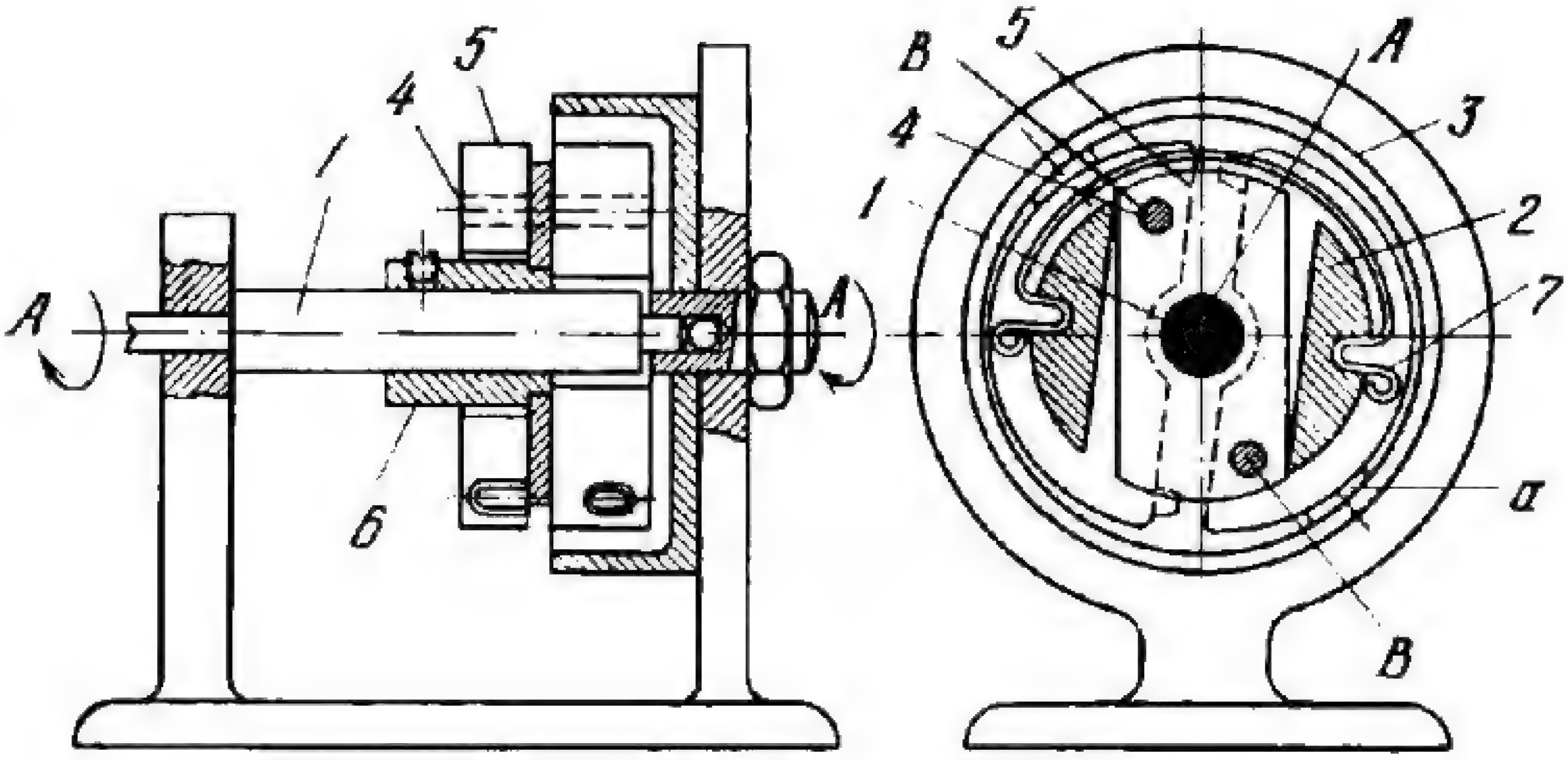
Link *1* and housing *2* rotate freely about fixed axis *A*. Link *1* has profiled lobes *a*. Balls *3* are located between lobes *a* and the inside surface of housing *2*. When link *1* rotates counterclockwise, balls *3* are jammed between lobes *a* and housing *2* which is thereby caused to rotate in the same direction. When link *1* rotates clockwise, balls *3* are released and housing *2* can rotate freely about axis *A*.

3412	ADJUSTABLE FRICTION CLUTCH MECHANISM	SmF C



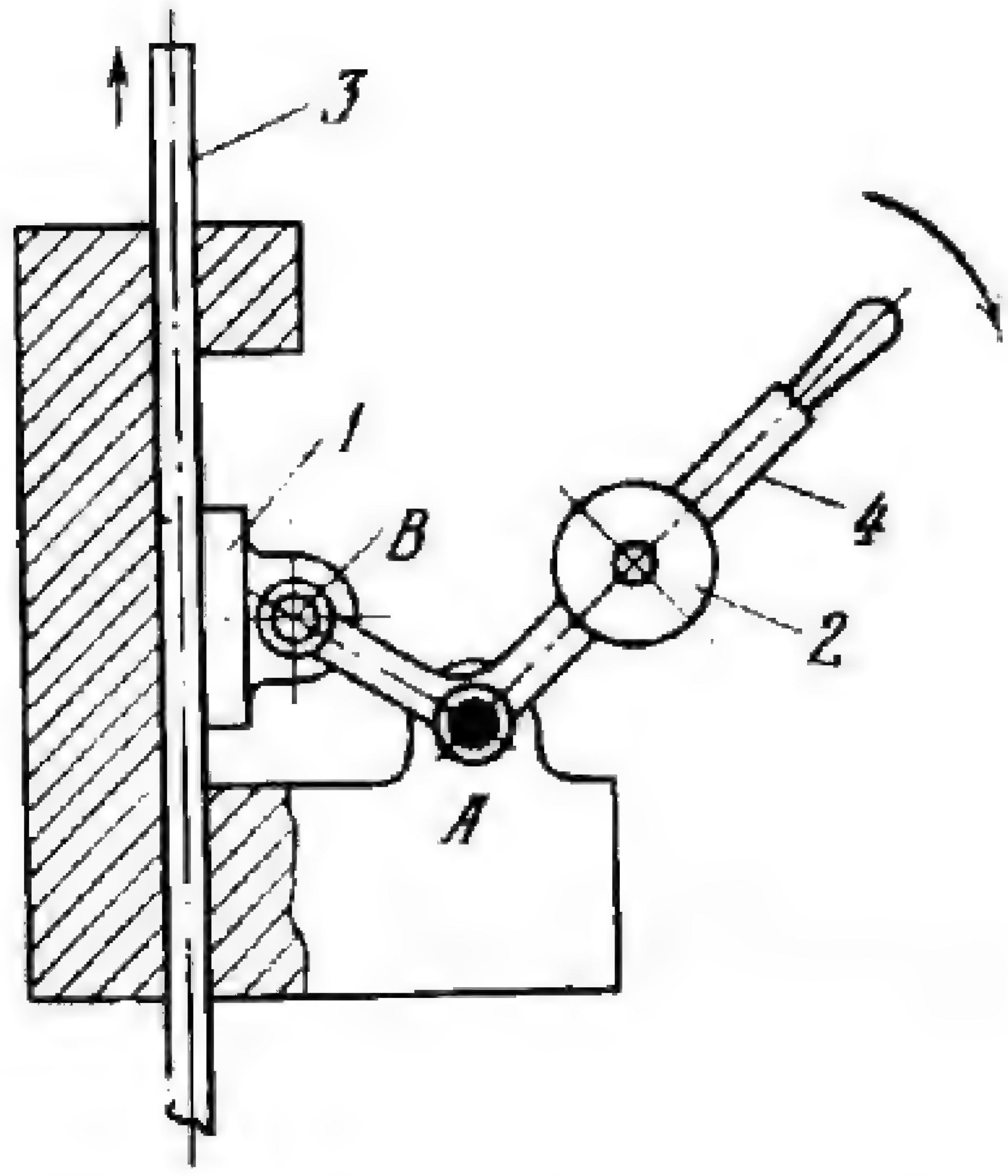
Shaft *1* rotates about fixed axis *A* and is connected by screw pair *D* to cone *2*. Internal cone *4* rotates about fixed axis *B* and has annular groove *a* containing balls *3*. When shaft *1* begins to rotate at a higher speed than cone *4*, cone *2* is moved along the thread of shaft *1* to the right, jamming balls *3* between cones *2* and *4*. As a result, cone *4* begins to rotate at the same speed as shaft *1*. If cone *4* rotates faster than shaft *1*, the cones spread apart, releasing balls *3* and disengaging the clutch.

3413	FRICTION GOVERNOR MECHANISM OF A NUMBER SWITCH IN AN AUTOMATIC EXCHANGE	SmF G



Shaft *1* rotates about fixed axis *A-A*. Rigidly attached to shaft *1* by means of collar *6* is crosspiece *5* in which pins *4* are fastened. Weights *2* with friction pads *a* turn about axes *B* of pins *4*. Housing *3* is rigidly attached to the base. When shaft *1* starts to rotate at a speed higher than the permissible value, weights *2* are spread by centrifugal force, overcoming the resistance of spring *7*, pads *a* are pressed against the inside surface of housing *3* and produce the braking effect that slows down shaft *1*.

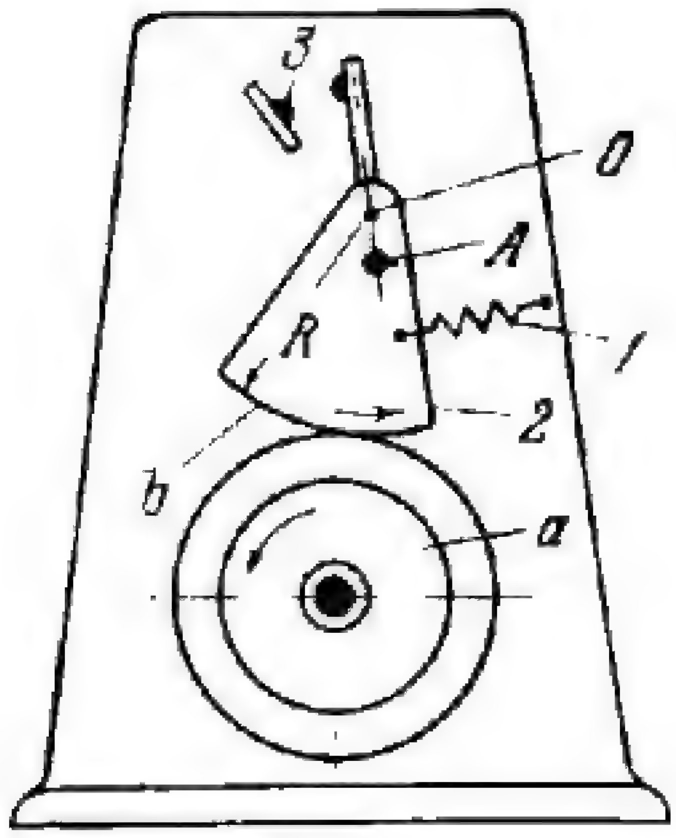
3414	FRICTION-TYPE STRIP CLAMPING MECHANISM	SmF GC



Shoe *1* is connected by turning pair *B* to lever *4* which turns about fixed axis *A*. When strip *3* starts to move downward, shoe *1* is jammed between lever *4* and the strip which is thereby clamped. Upward motion of strip *3* releases shoe *1* and turns lever *4* clockwise. Weight *2* facilitates the unclamping of the mechanism.

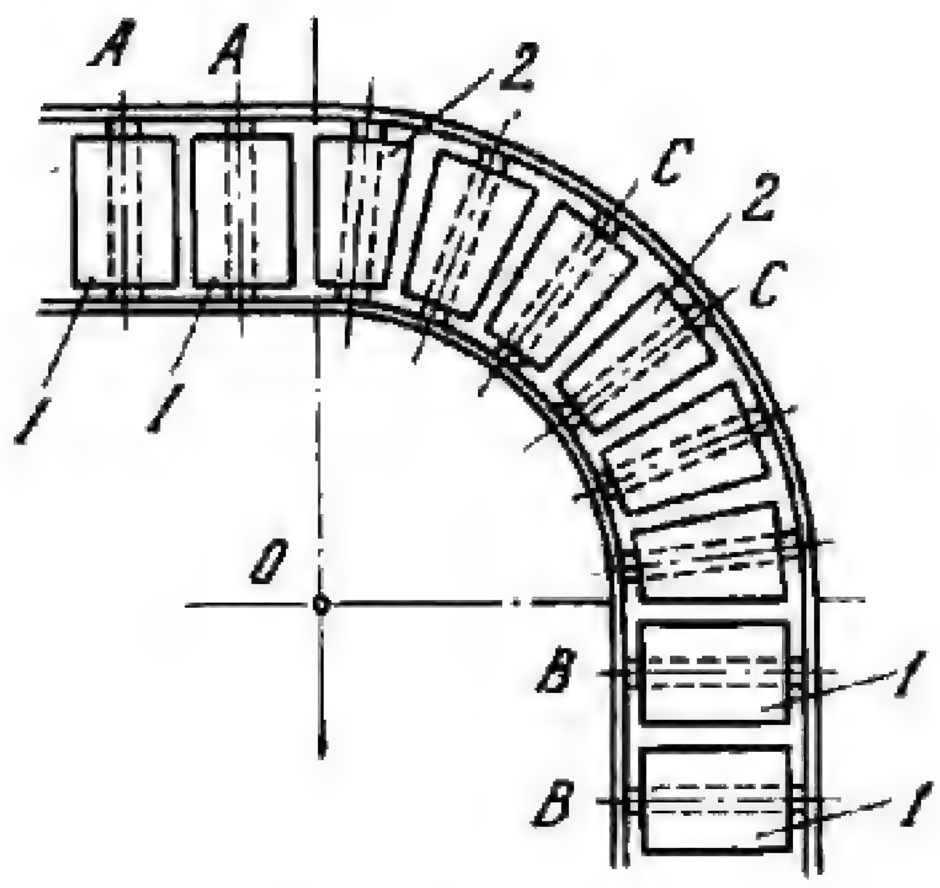
9. MECHANISMS OF OTHER FUNCTIONAL DEVICES (3415 and 3416)

3415	**FRICTION MECHANISM OF THE KOCHEGAROV AUTOMATIC GAUGING DEVICE FOR GRINDING OPERATIONS**	SmF FD



Segment *2* turns about fixed axis *A* and the centre *O* of its circular working surface *b* does not coincide with axis *A*. Spring *1* holds segment *2* against the surface being ground on workpiece *a* and tends to turn the segment counterclockwise. If centre *O* and axis *A* are close together, then with a small reduction in diameter of workpiece *a*, segment *2* swings through a relatively large angle, closing contact *3* which controls the grinding wheel feed mechanism.

3416	**FRICTION MECHANISM OF A CURVE IN A ROLL TRAIN**	SmF FD



The straight portions of the roll train have cylindrical rollers *1* of equal diameter which rotate about parallel fixed axes *A* and parallel fixed axes *B*. The curves have identical tapered rollers *2* which rotate about fixed axes *C*, intersecting at common point *O*. The taper angle of rollers *2* should be less than the angle of friction. Otherwise, the loads will slide off the roll train on the curve.

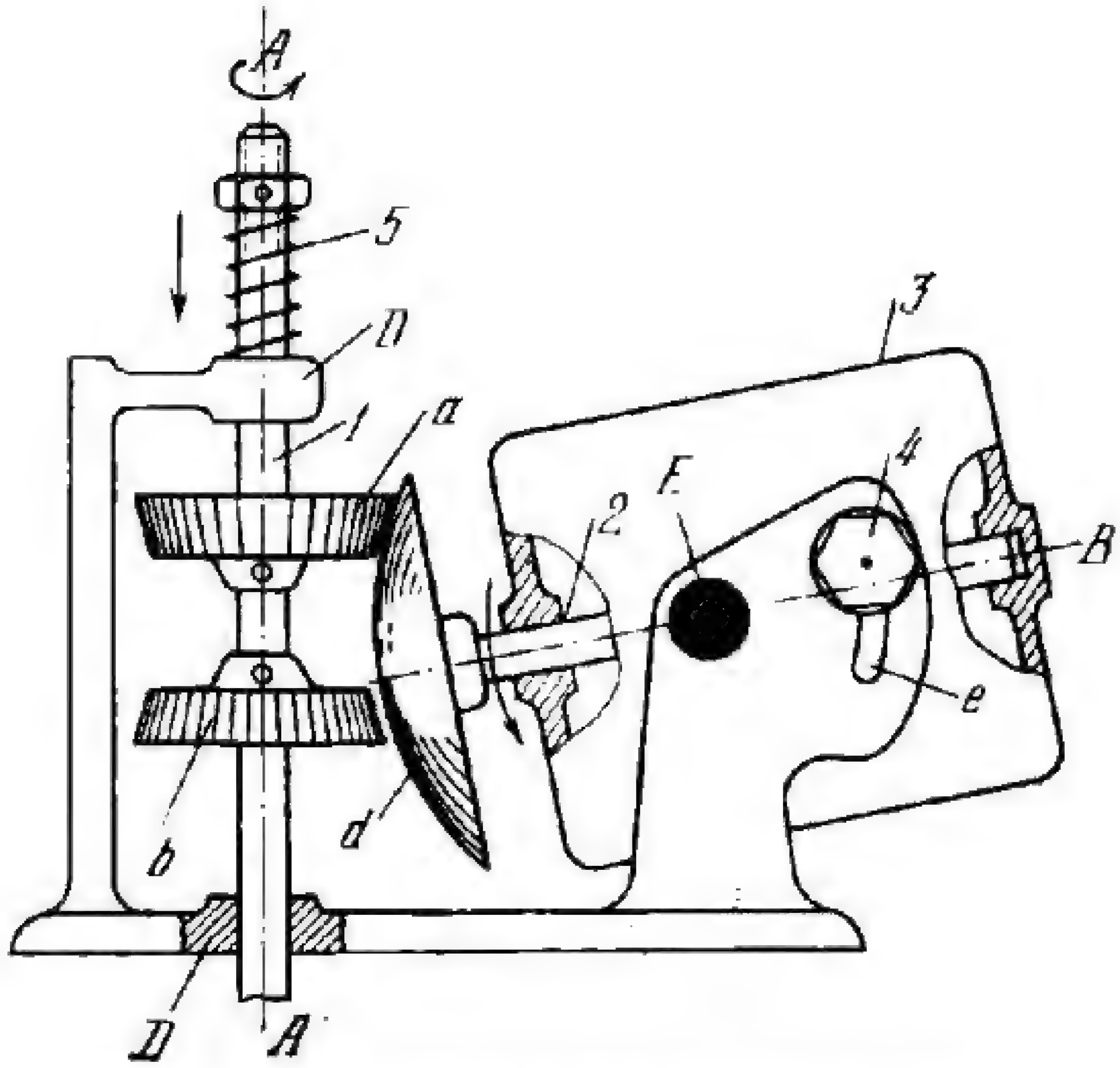
SECTION TWENTY-FIVE

Complex Friction Mechanisms CF

1. General-Purpose Multiple-Link Mechanisms ML (3417 through 3431)
2. Mechanisms for Generating Curves Ge (3432)
3. Mechanisms for Mathematical Operations MO (3433 through 3442)
4. Mechanisms of Measuring and Testing Devices M (3443, 3444 and 3445)
5. Dwell Mechanisms D (3446 and 3447)
6. Sorting and Feeding Mechanisms SF (3448)
7. Clutch and Coupling Mechanisms C (3449 through 3453)
8. Switching, Engaging and Disengaging Mechanisms SE (3454)
9. Governor Mechanisms G (3455, 3456 and 3457)
10. Hammer, Press and Die Mechanisms HP (3458 and 3459)
11. Infinitely Variable Transmission Mechanisms IV (3460 through 3478)

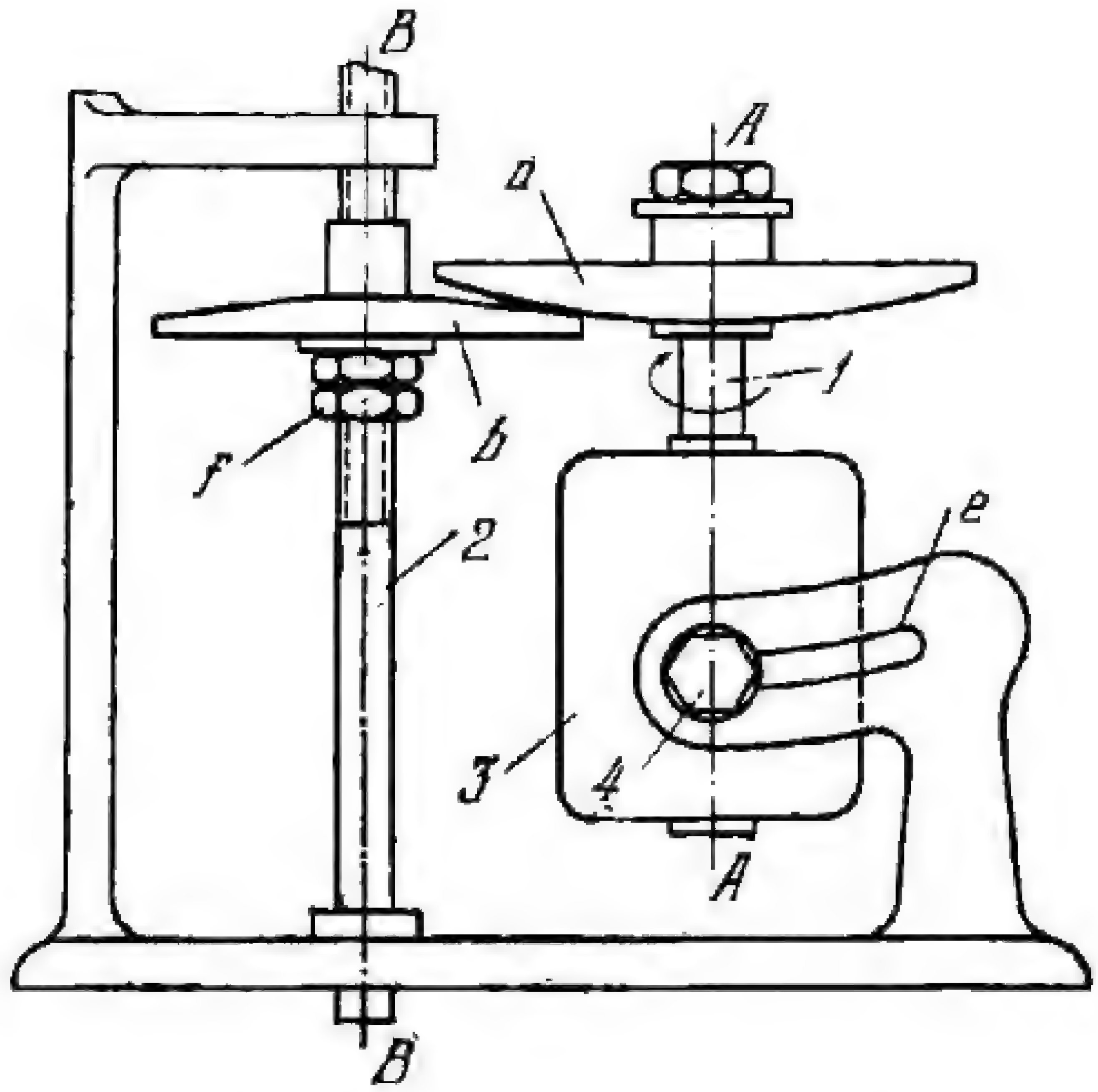
1. GENERAL-PURPOSE MULTIPLE-LINK MECHANISMS
(3417 through 3431)

3417	**FRICTION-TYPE REVERSING MECHANISM**	CF ML



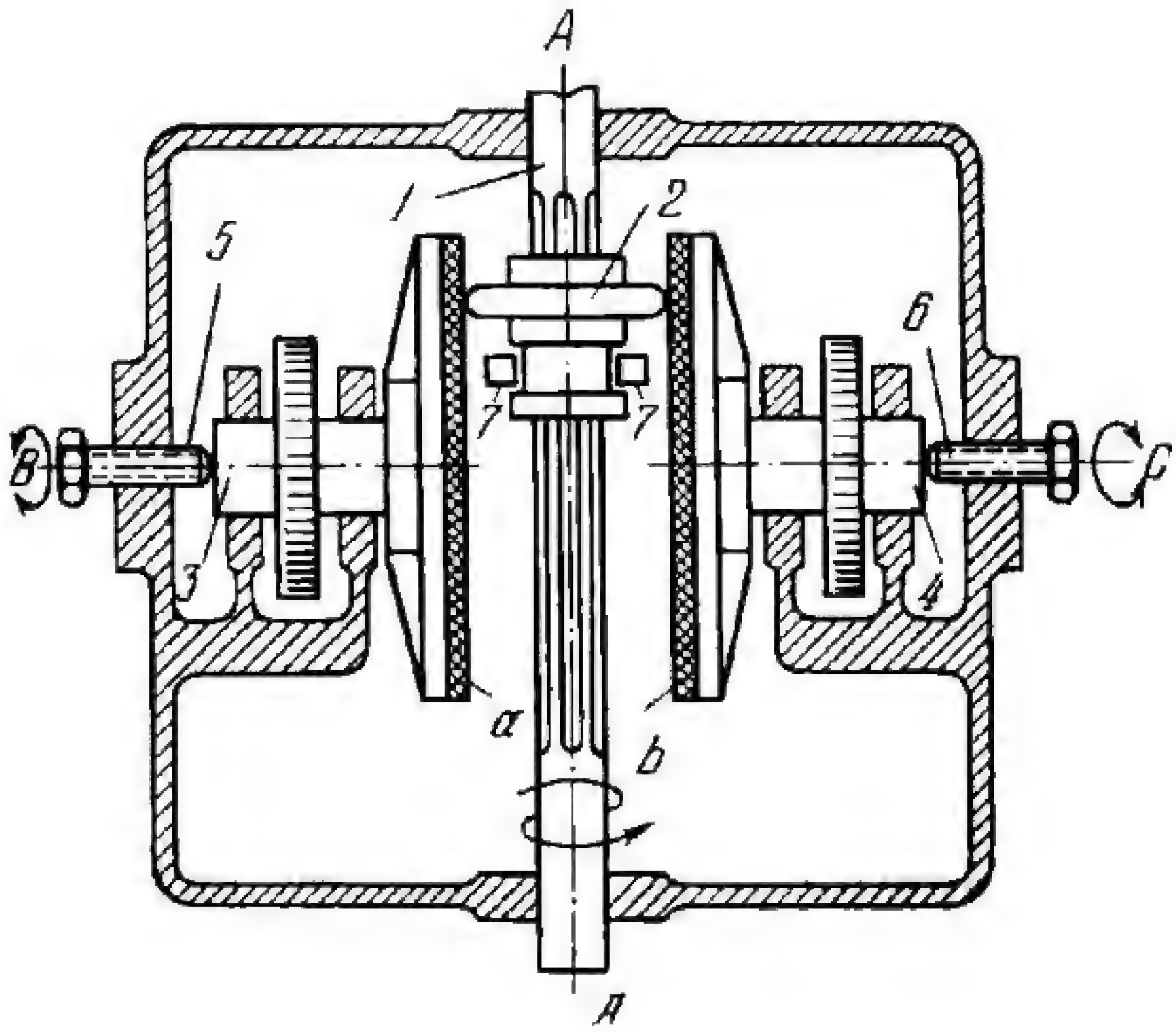
Conical friction wheels *a* and *b* are keyed to shaft *1* and rotate about fixed axis *A-A*. Shaft *2*, driven by motor *3*, rotates about axis *B* and has spherical friction disk *d* keyed to it. Shaft *1* can be shifted axially along axis *A-A* in fixed guides *D-D*. When shaft *1* is shifted downward, wheel *a* contacts disk *d* and shaft *1* begins to rotate. If shaft *1* is shifted upward, wheel *b* contacts disk *d*, and both the direction and speed of shaft *1* are changed. The speed of shaft *1* can be varied by changing the angle of inclination of axis *B* of disk *d*. This is done by swivelling motor *3* about fixed axis *E* and clamping it in the required position with bolt *4* which moves along circular slot *e*. Spring *5* holds wheel *b* in contact with disk *d*.

3418	FRICTION-TYPE SPEED-CHANGING MECHANISM	CF ML



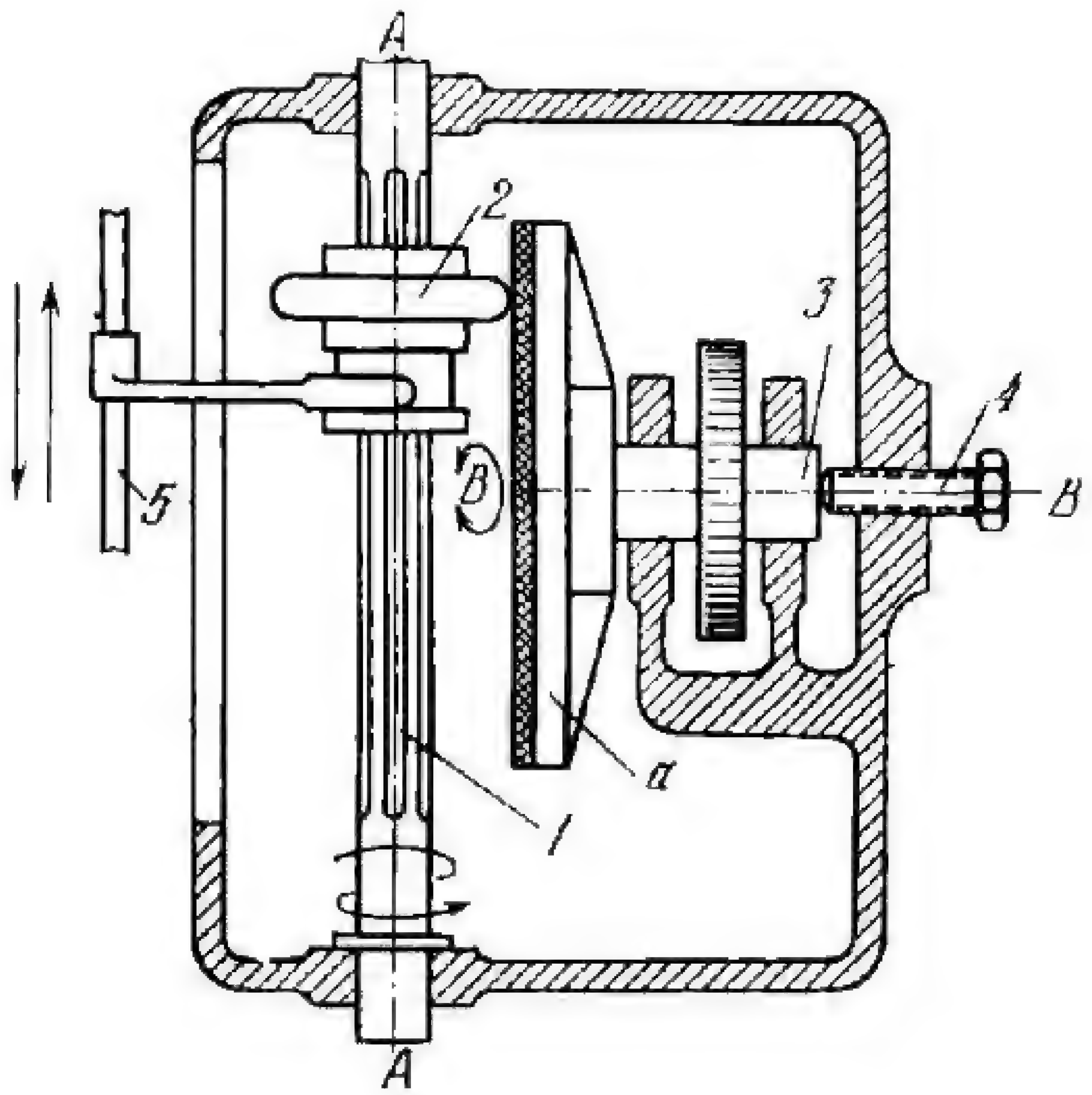
Shaft *1* with rigidly mounted spherical friction disk *a* rotates about fixed axis *A-A* and is driven by motor *3*. Disk *a* contacts tapered disk *b* which is rigidly mounted on shaft *2* and rotates about fixed axis *B-B*. Shaft *1* can be set in various positions by adjusting motor *3* along fixed slot *e* and clamping with bolt *4*. Disks *a* and *b* are pressed together by nut and lock nut *f*. The transmission ratio i_{12} from shaft *1* to shaft *2* depends on the position of shaft *1* which determines the radii of the contact circles on disks *a* and *b*.

3419	FRICTION-TYPE REVERSING MECHANISM FOR TWO SHAFTS	CF ML



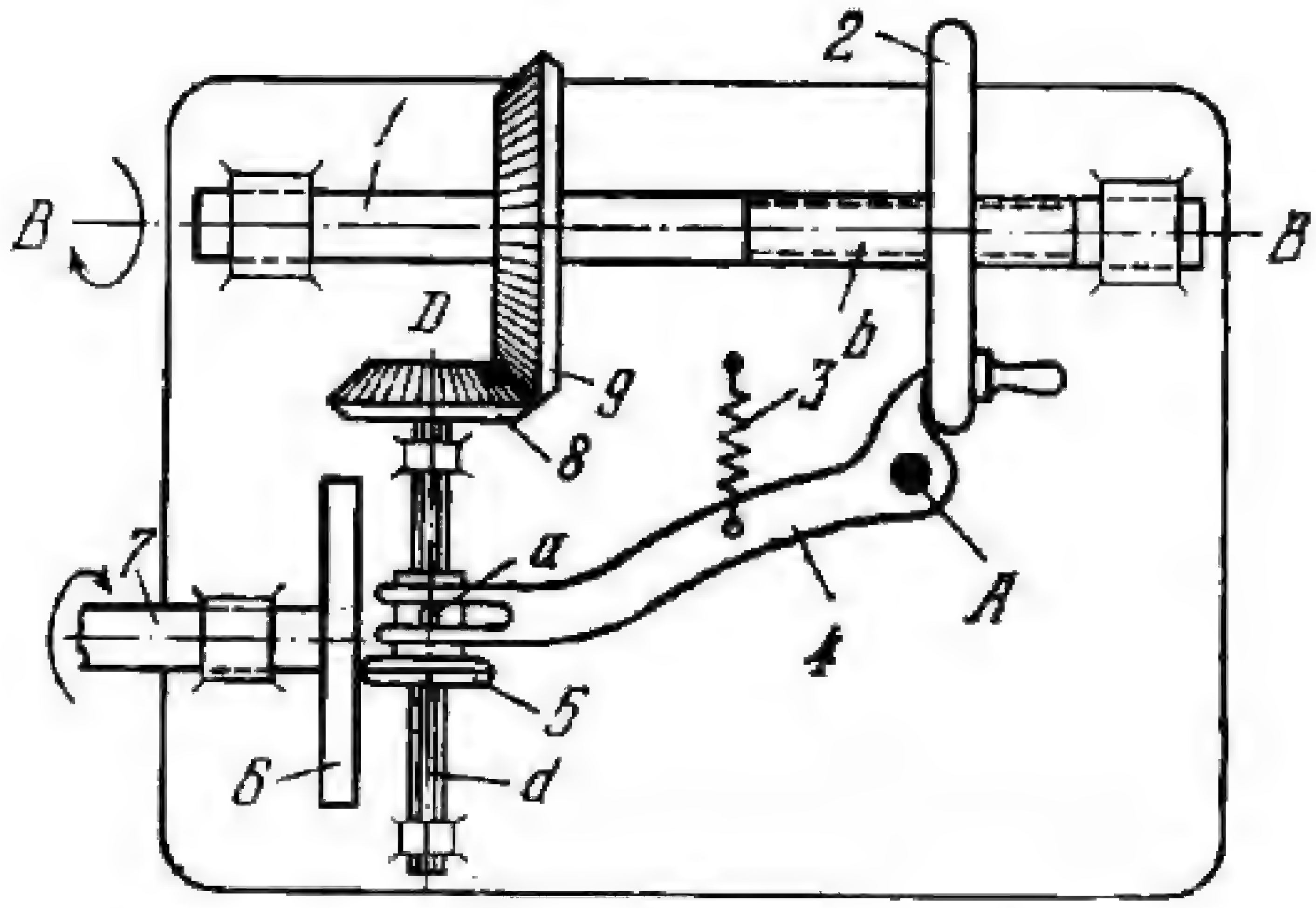
Spline shaft 1 rotates about fixed axis *A-A*. Coaxial shafts 3 and 4 with friction disks *a* and *b* rotate about fixed axes *B* and *C*. By means of device 7 (shown schematically), friction wheel 2 can be shifted along the splines of shaft 1 so that it contacts disks *a* and *b* at points above or below axes *B* and *C*. Thus wheel 2 transmits rotation to disks *a* and *b* (and shafts 3 and 4) in opposite and reversible directions. Disks *a* and *b* are pressed against wheel 2 by screws 5 and 6.

3420	FRICTION-TYPE REVERSING MECHANISM	CF ML



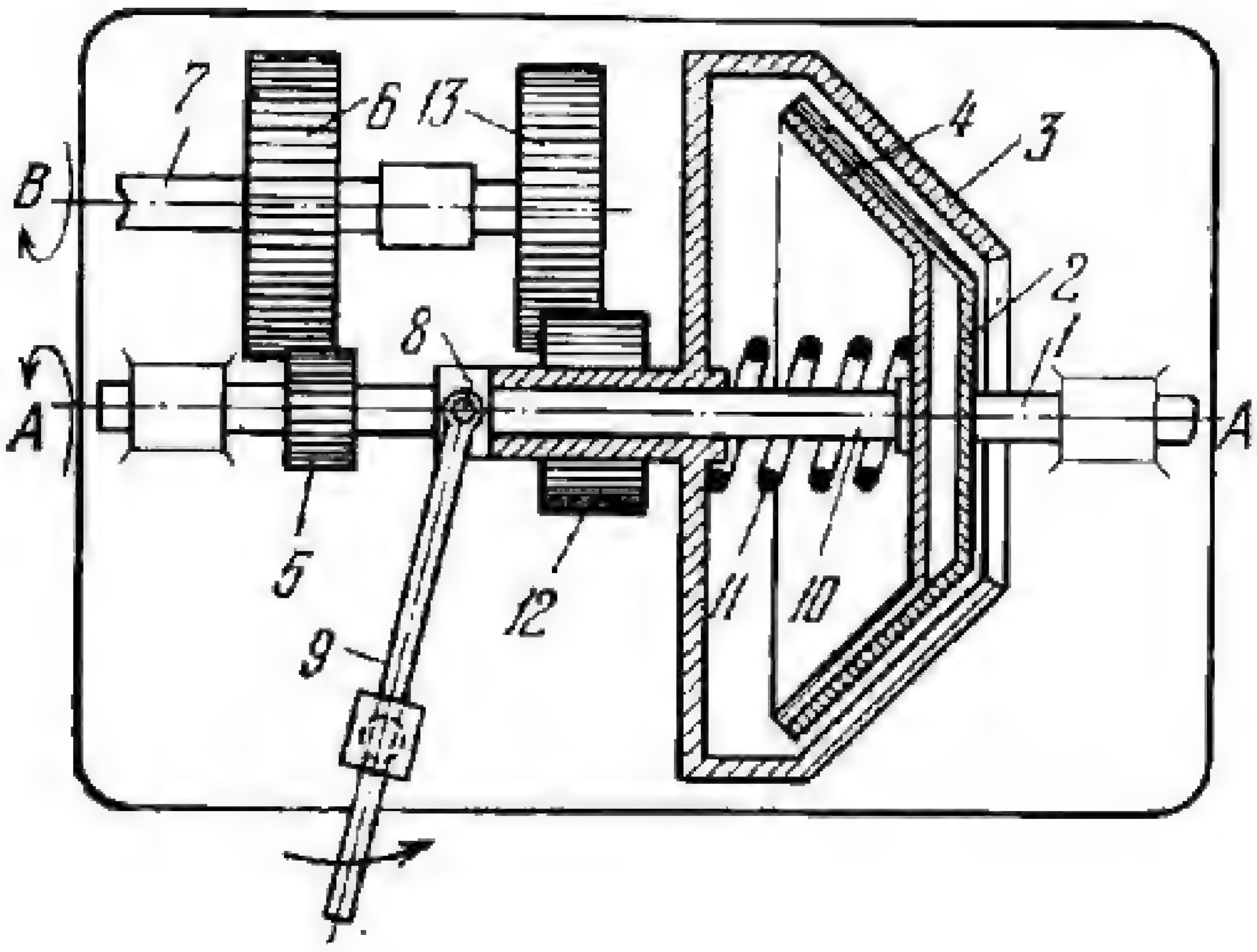
Spline shaft *1* rotates about fixed axis *A-A*. Shaft *3* with disk *a* rotates about fixed axis *B-B*. By means of device *5* (shown schematically) friction wheel *2* can be shifted along the splines of shaft *1* so that it contacts disk *a* at points above or below axis *B-B*. Thus wheel *2* transmits rotation at variable speed and in either direction to disk *a* and shaft *3*. Disk *a* is pressed against wheel *2* by screw *4*.

3421	QUELL FRICTIONAL AND BEVEL GEARING MECHANISM	CF ML



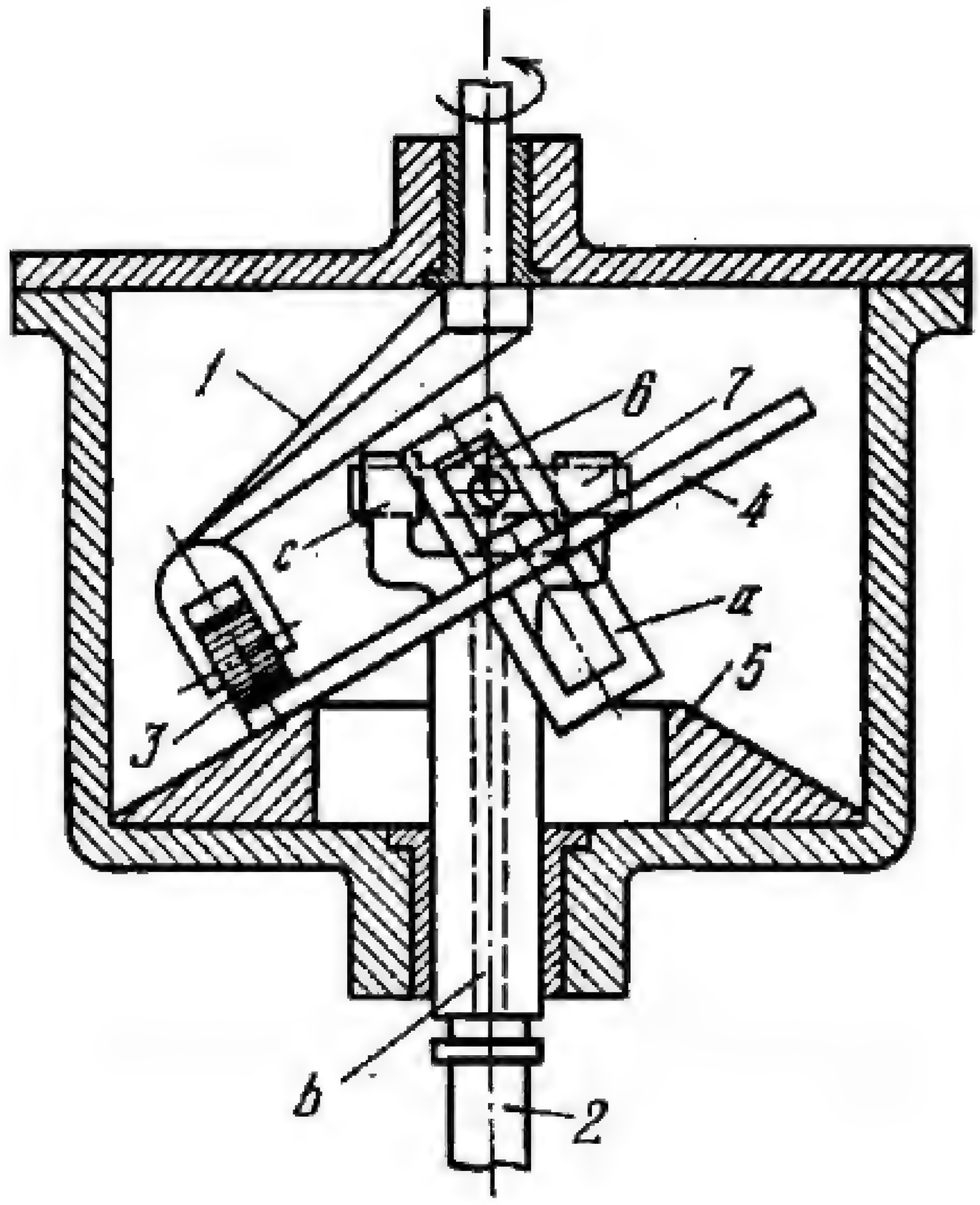
Driven shaft *1* rotates about fixed axis *B-B*. Handwheel *2* is connected by a screw pair to thread *b* of shaft *1*. Lever *4* turns about fixed axis *A* and is held in constant contact with handwheel *2* by spring *3*. The forked end of lever *4* slides along pin *a* of the hub of friction wheel *5* which can be shifted on feather key *d* along axis *D*. Wheel *5* engages friction disk *6* which is keyed to driving shaft *7*. The required speed of shaft *1* is obtained by adjusting handwheel *2* along axis *B-B*, and rotation is transmitted from shaft *7* through friction disk *6*, friction wheel *5* and bevel gears *8* and *9* to shaft *1*.

TWO-SPEED FRICTIONAL AND SPUR GEARING MECHANISM



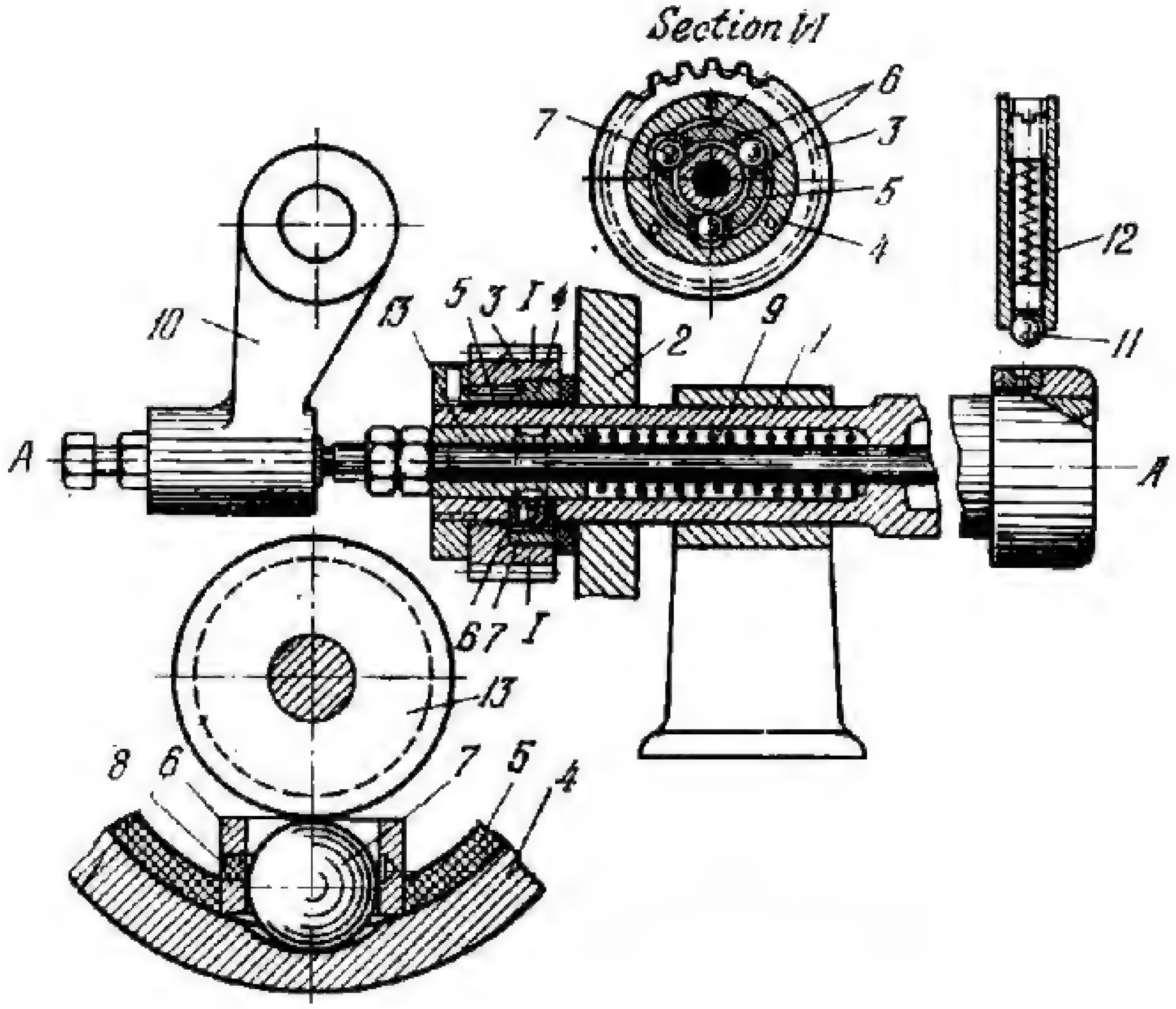
Driving shaft *1* rotates in either direction about fixed axis *A-A* and is rigidly attached to cone *2* which engages internal cone *3* at the high speed of driven shaft *7* and external cone *4* at the low speed. Shaft *7* rotates about fixed axis *B*. As shown, rotation is transmitted through cone *4*, held against cone *2* by spring *11*, and gears *5* and *6*, keyed to shafts *10* and *7*. If lever *9* is turned counterclockwise, collar *8* shifts gear *5* and shaft *10* with cone *4* to the left, disengaging cones *4* and *2*, and engaging cones *3* and *2*. Then rotation is transmitted through gears *12* and *13*, keyed to the sleeve of cone *3* and to shaft *7*.

3423	KUZNETSOV SLANTED-WASHER PLANETARY FRICTION DRIVE MECHANISM	CF ML



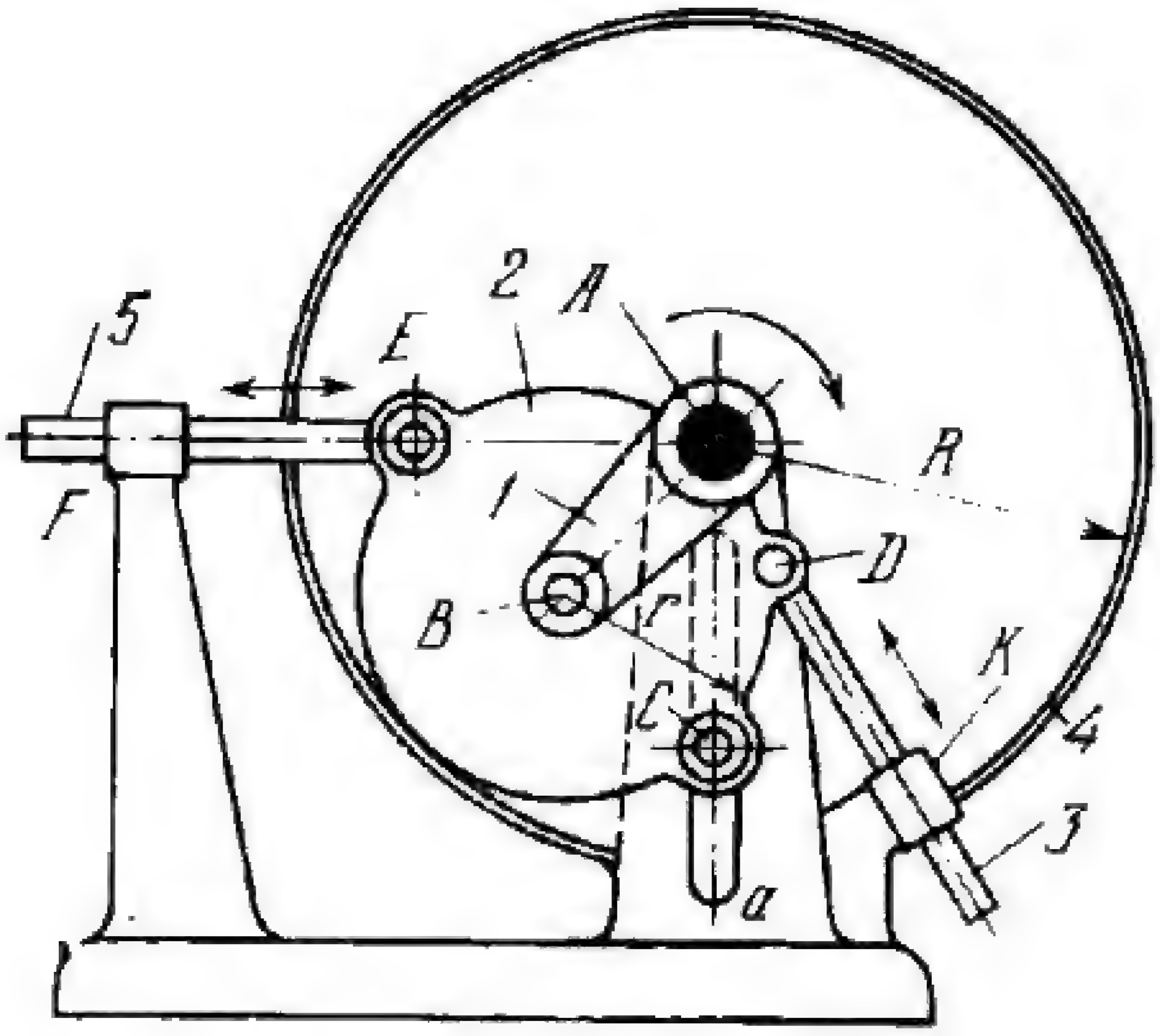
Rotation is transmitted from crank *1* to driven shaft *2* by means of roller *3* which presses slanted washer *4* to fixed cone *5*, imparting a complex spatial motion to the washer. Washer *4* has slotted member *a* whose slot slides along block *6* which is pivoted to pin *c*. Pin *c* is mounted in clevis *7* which can be adjusted along feather key *b* of shaft *2* to change the height position of block *6* and, thereby, the speed of shaft *2*.

3424	FRICTION-TYPE ENGAGEMENT MECHANISM FOR INTERMITTENT ROTATION	CF ML



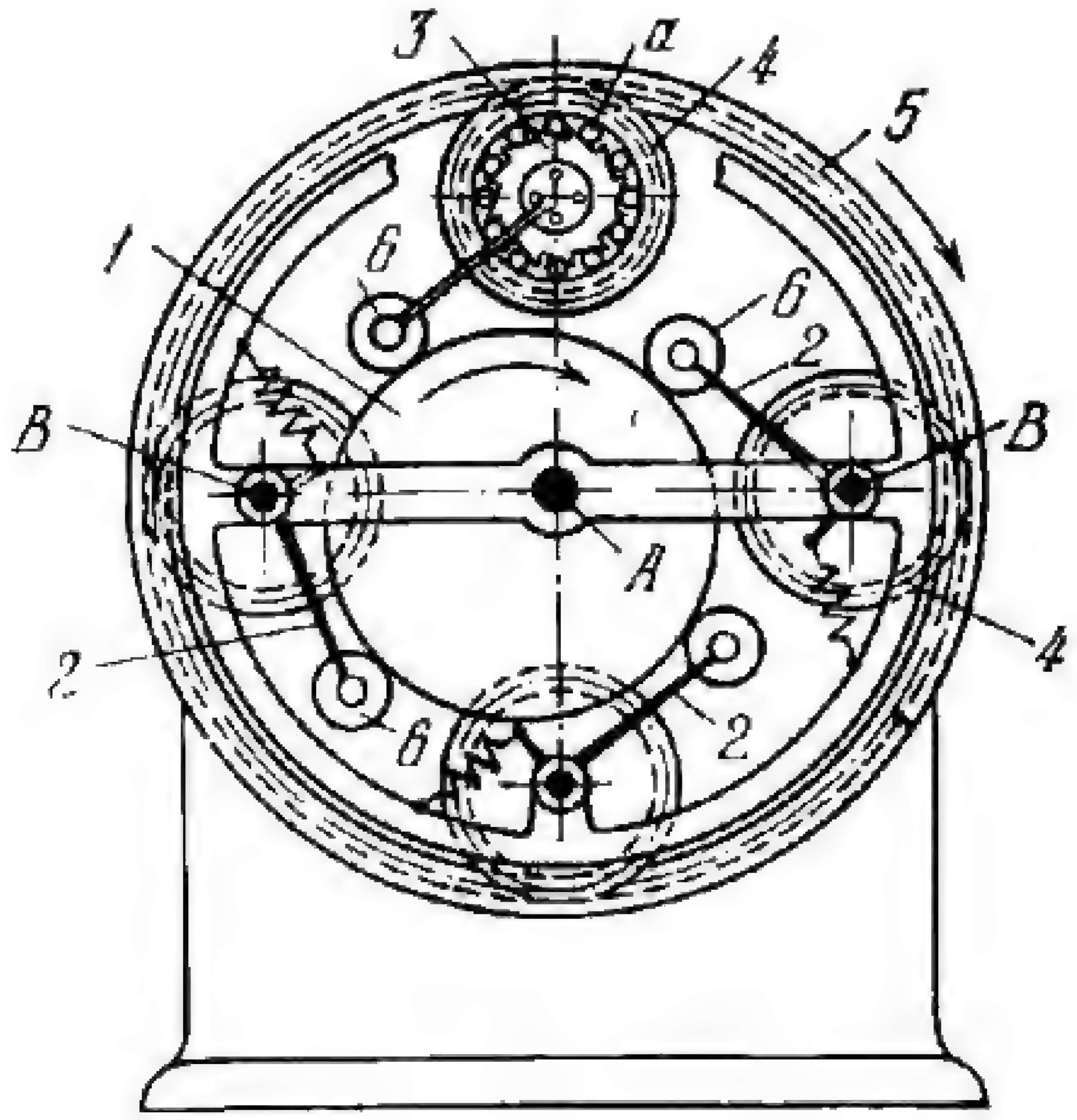
Spindle *1*, in housing *2*, is driven about fixed axis *A*-*A* by gear *3* in which sleeve *4* and ball cage *5* are rigidly mounted. In the holes of cage *5* are guide bushings *6* with balls *7* which are acted on by springs *8*. Mounted on plunger *9* is sleeve *13* which has an external semicircular groove. The plunger is shifted axially by lever *10* and operates a chuck (not shown) that clamps the workpiece. When plunger *9* is shifted to the right, the chuck opens and balls *7* enter the semicircular groove on sleeve *13*, disengaging sleeve *4* and gear *3* which then rotates freely about spindle *1*. Here the spindle is locked in a definite position by ball *11* of locking plunger *12*. When plunger *9* is shifted to the left, the workpiece is clamped by the chuck, sleeve *13* is shifted to the left by the spring, and balls *7* are forced outward from the semicircular groove in sleeve *13* so that they engage recesses in sleeve *4*. This engages gear *3* to spindle *1* which begins to rotate.

3425	FRICTION-LEVER PLANETARY CARDAN CIRCLE MECHANISM	CF ML



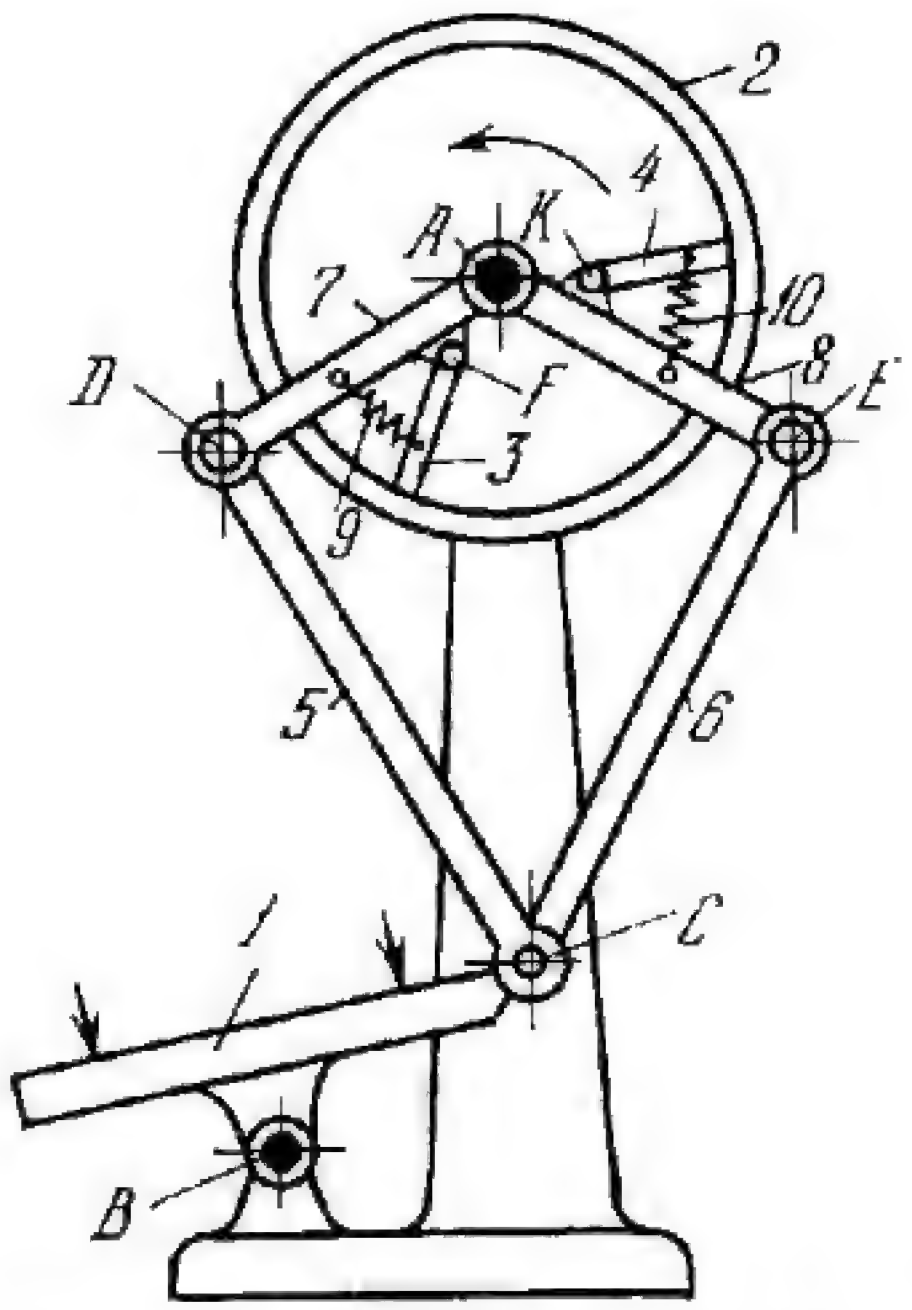
Driver *1* rotates about fixed axis *A* and is connected by turning pair *B* to friction wheel *2* which rolls without slipping inside the rim of fixed friction wheel *4*. The dimensions of the links comply with the condition: $R = 2r$, where R and r are the radii of the large and small wheels. Pin *C* of wheel *2*, whose axis lies on a circle of radius r, slides along straight guide *a*, whose axis passes through point *A*. Wheel *2* is connected by turning pairs *E* and *D* to links *5* and *3* which reciprocate in fixed guides *F* and *K* whose axes pass through point *A*. Points *E* and *D* also lie on a circle of radius r. When driver *1* rotates, links *3* and *5* reciprocate.

3426	FRICTION-LEVER FREE-WHEELING CLUTCH MECHANISM	CF ML



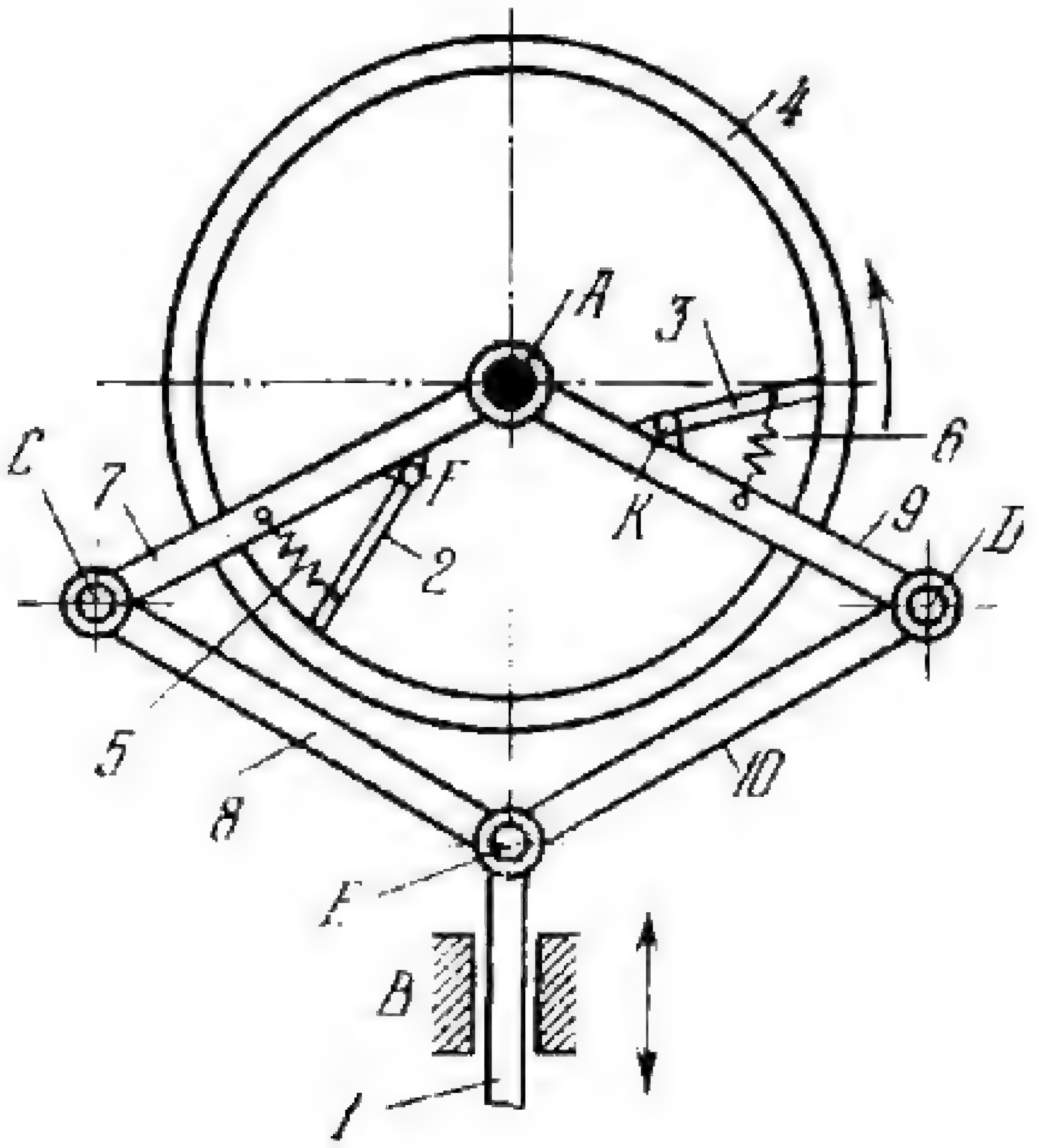
Round eccentric *1* rotates about fixed axis *A*. Levers *2* turn about fixed axes *B* and carry rollers *6* which roll along the working surface of eccentric *1*. Levers *2* are rigidly attached to inner clutch members *3* and transmit clockwise rotation through balls *a* to outer members (gears) *4* when the balls jam between the cam surfaces of member *3* and the inner cylindrical surface of member *4*. Gears *4* mesh with internal gear *5* which they rotate about axis *A*.

3427	FRICTION-LEVER-RATCHET DRUM DRIVE MECHANISM	CF ML



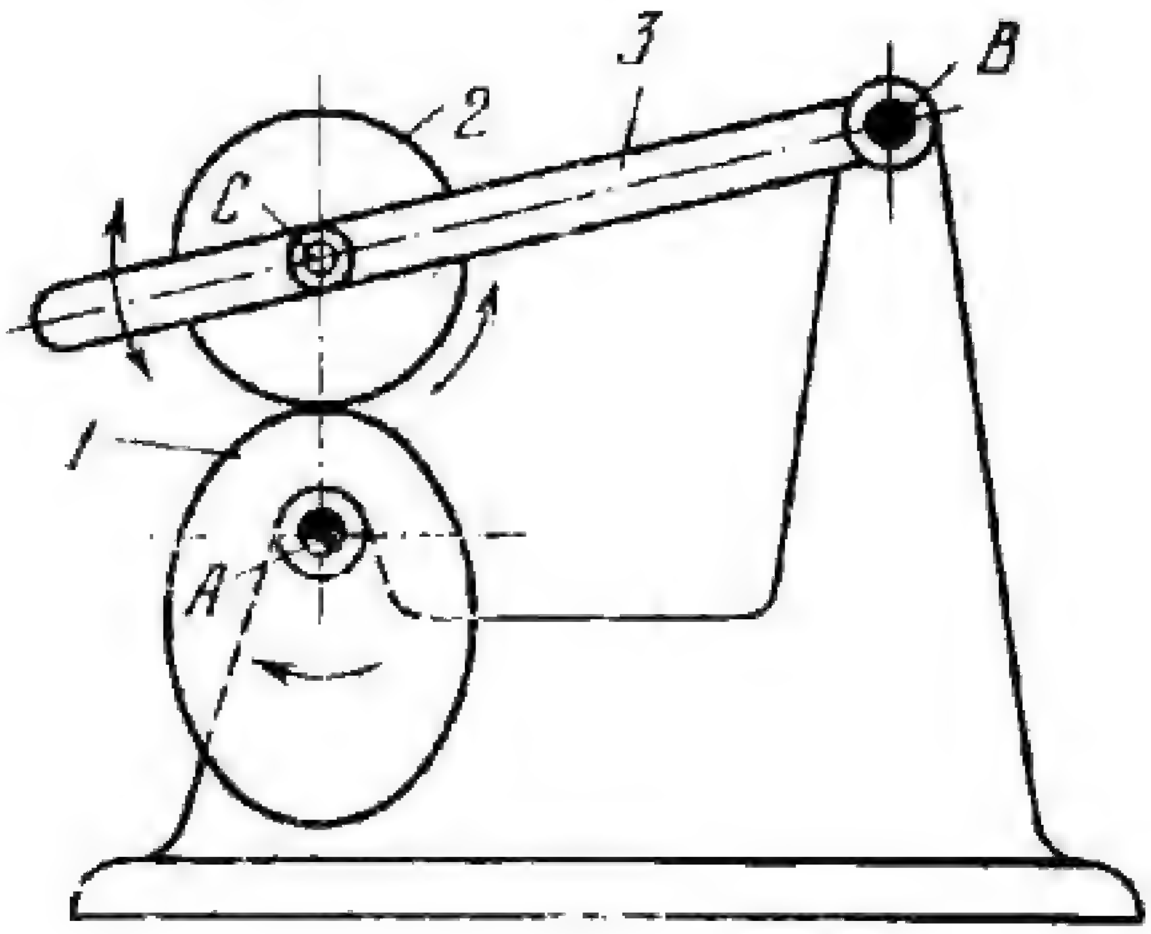
Drum *2* rotates about fixed axis *A*. Driving link *1*, designed as a treadle, oscillates about fixed axis *B* and is connected by turning pairs *C* to links *5* and *6* which, in turn, are connected by turning pairs *D* and *E* to links *7* and *8*. Links *7* and *8* turn about axis *A* and are connected by turning pairs *F* and *K* to pawls *3* and *4*. The dimensions of the links comply with the conditions: $\overline{CD} = \overline{CE}$ and $\overline{AD} = \overline{AE}$. Pawls *3* and *4* are held in contact with the inside surface of drum *2* by springs *9* and *10*. When treadle *1* is oscillated, pawls *3* and *4* alternately engage drum *2* and rotate it counterclockwise.

3428	FRICTION-LEVER-RATCHET DRUM DRIVE MECHANISM	CF ML



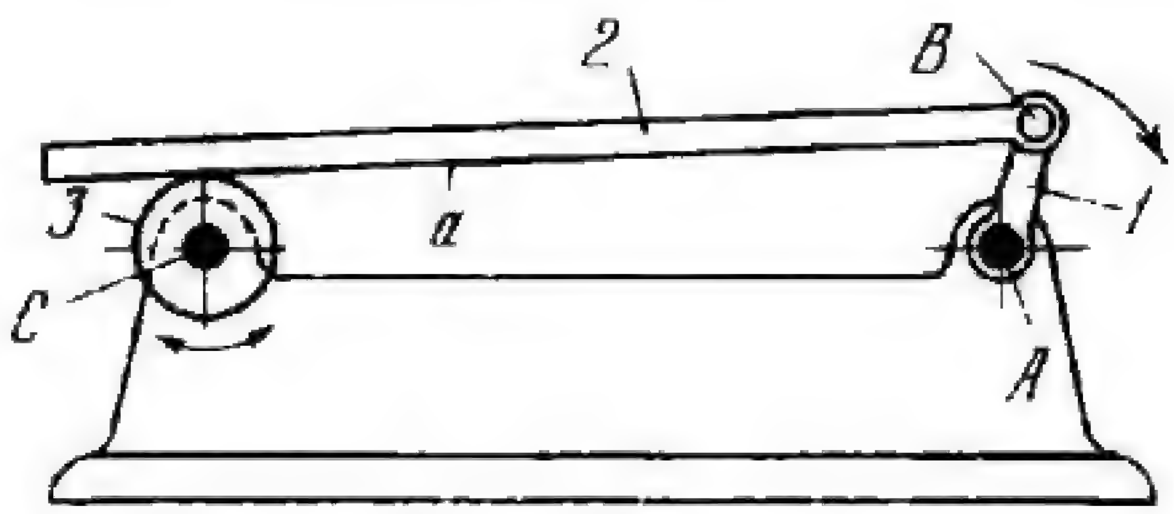
Drum 4 rotates about fixed axis A. Driving link 1 reciprocates in fixed guide B and is connected by turning pairs E to links 8 and 10 which, in turn, are connected by turning pairs C and D to links 7 and 9. Links 7 and 9 turn about axis A and are connected by turning pairs F and K to pawls 2 and 3. The dimensions of the links comply with the condition: $\overline{AD} = \overline{DE} = \overline{EC} = \overline{CA}$. Pawls 2 and 3 are held in contact with the inside surface of drum 4 by springs 5 and 6. When link 1 reciprocates, pawls 2 and 3 alternately engage drum 4 and rotate it counterclockwise.

3429	**FRICTION-LEVER ELLIPTIC WHEEL MECHANISM**	CF ML



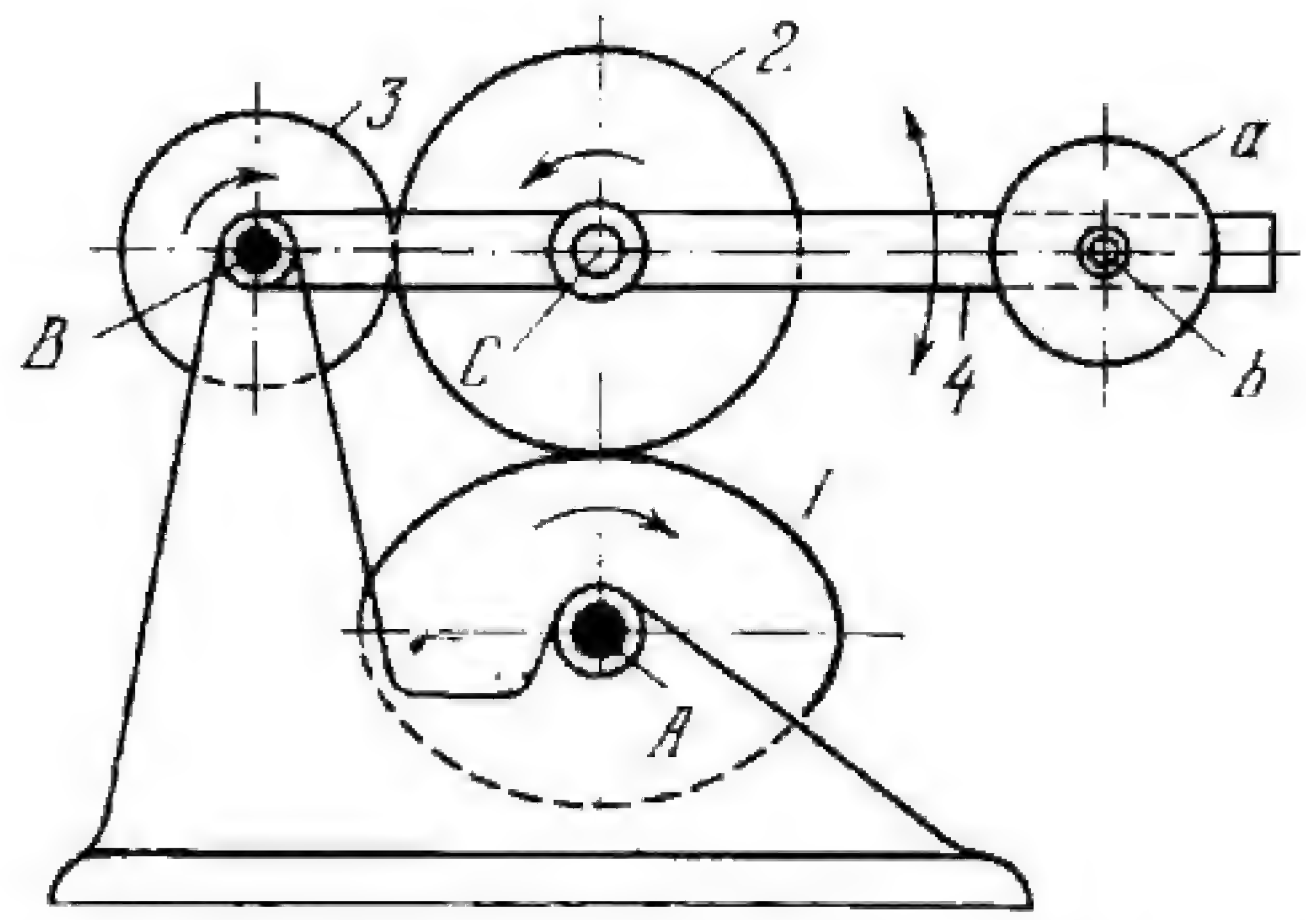
Elliptic friction wheel *1* rotates about fixed axis *A*, passing through a focus of the ellipse, and contacts friction wheel *2*. Lever *3* turns about fixed axis *B* and is connected by turning pair *C* to wheel *2*. When wheel *1* rotates, wheel *2* has a complex motion consisting of rotation about axis *C* and oscillation about axis *B*. Wheel *2* is held by gravity in contact with wheel *1*.

3430	**FRICTION-LEVER MECHANISM**	CF ML



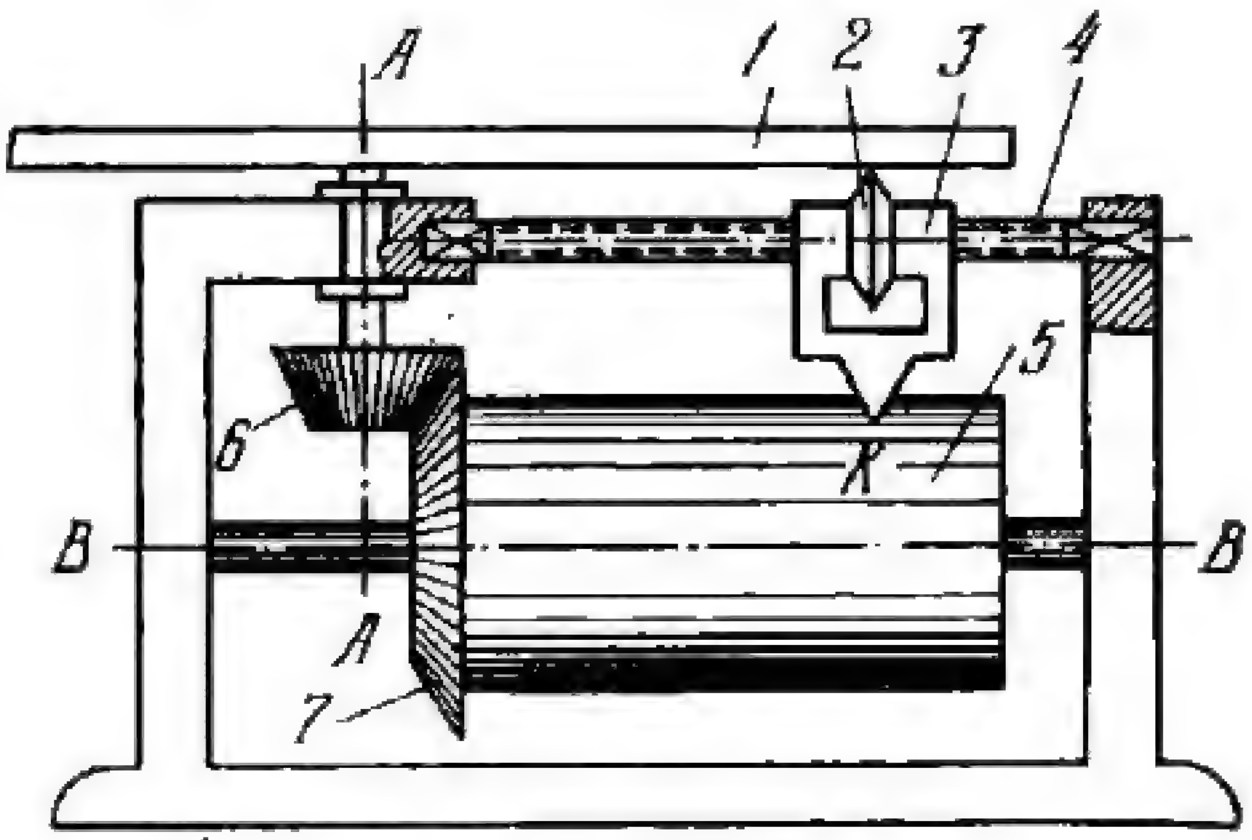
Crank *1* rotates about fixed axis *A* and is connected by turning pair *B* to link *2* which is held by gravity with its surface *a* in contact with friction wheel *3*. Wheel *3* turns about fixed axis *C*. When crank *1* rotates, wheel *3* rotates alternately in both directions.

3431	FRICTION-LEVER DIFFERENTIAL MECHANISM WITH A NONCIRCULAR FRICTION WHEEL	CF ML



Noncircular friction wheel *1* rotates about fixed axis *A*. Lever *4* turns about fixed axis *B* and is connected by turning pair *C* to round friction wheel *2* which is held in contact with wheel *1* by weight *a*. Weight *a* can be adjusted along lever *4* and clamped in the required position by screw *b*. Wheel *2* engages round friction wheel *3* which rotates about axis *B*. When wheel *1* rotates at constant speed, wheel *3* rotates at nonuniform speed and wheel *2* has a complex motion consisting of rotation about axis *C* and oscillation about axis *B*.

3432	FRICTIONAL AND BEVEL GEARING MECHANISM FOR TRACING LOGARITHMIC OR EXPONENTIAL CURVES	CF Ge



Friction disk *1* rotates about fixed axis *A-A* and its working surface is pressed against sharp-edged roller *2* which is a nut moving along fixed screw *4*. Keyed to the shaft of disk *1* is bevel gear *6* which meshes with bevel gear *7*. Gear *7* is rigidly attached to drum *5* and rotates about fixed axis *B-B*. When disk *1* rotates, roller *2* is rotated and moves axially, traversing carriage *3* along screw *4*. At the same time, drum *5* rotates about axis *B-B*. The trace of stylus *K* on drum *5* is an exponential curve with the equation

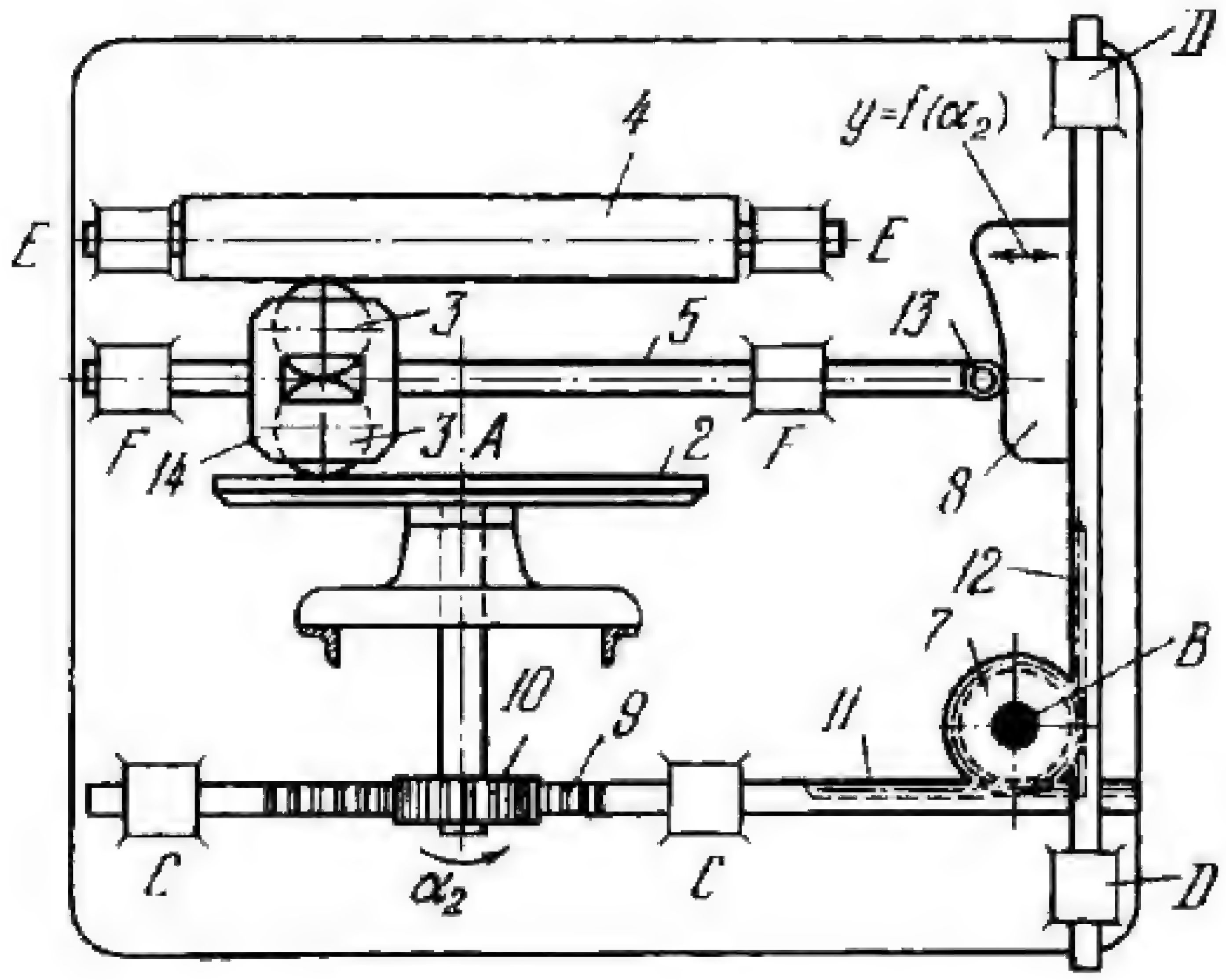
$$y = Ae^{\frac{mp}{\pi d}x}$$

where p is the thread pitch of the screw, d is the diameter of roller *2*, and m is the proportionality factor relating the displacement of the drum surface, with respect to tracing point K, and the angle of rotation of disk *1*. If the angle of rotation of disk *1* is φ and the relative displacement of the drum (circumferential length) is x, then

$$m = \frac{\varphi}{x}.$$

3. MECHANISMS FOR MATHEMATICAL OPERATIONS
(3433 through 3442)

3433	FRICTION-TYPE MECHANISM OF A BALL-TYPE INTEGRATOR	CF MO

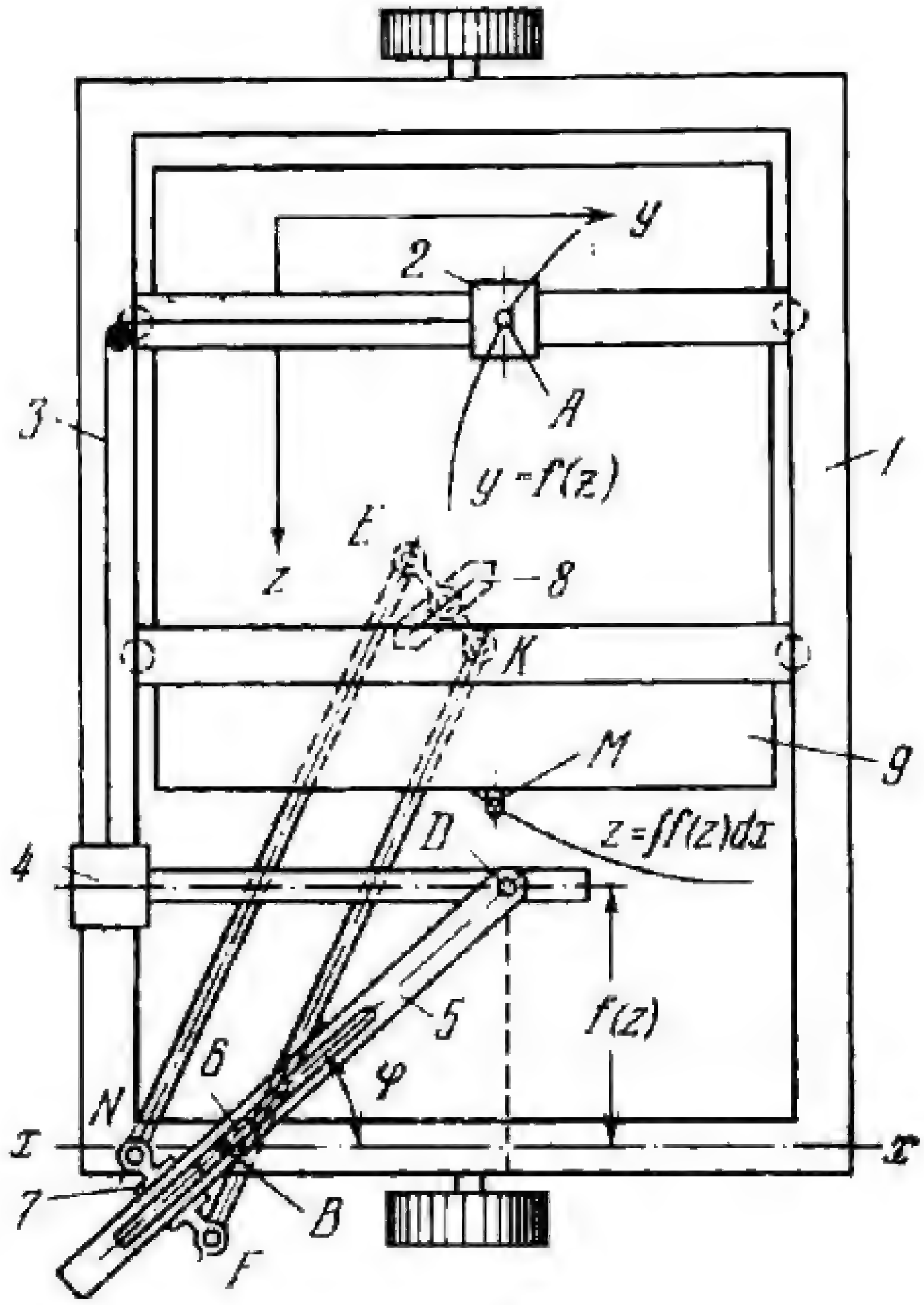


Pinion 7 rotates about fixed axis *B* and meshes with two racks, *11* and *12*, which slide in fixed guides *C-C* and *D-D*. Rack *11* is integral with rack *9* which meshes with pinion *10*. Pinion *10* is rigidly attached to disk *2* which rotates about fixed axis *A*. Rack *12* carries cam *8*. Link *5* slides in guides *F-F* and carries roller *13* which rolls along the working surface of cam *8*. Roll *4* rotates about fixed axis *E-E*. The rotation of pinion *7* is transmitted to disk *2* of the integrator and further through balls *3* held in carriage *14* to roll *4*. Carriage *14* has supplementary traverse along a radius of disk *2* due to the action of cam *8* whose profile corresponds to the given function of the angle of rotation α_2 of the integrator disk: $y = f(\alpha_2)$. With no slippage, the instrument provides for the following relationship between the rotation of disk *2* and roll *4*:

$$\alpha_4 = \alpha_{40} + \frac{1}{r_4} \int_{\alpha_{20}}^{\alpha_2} f(\alpha_2) d\alpha_2$$

where α_4 and α_{40} are angles of rotation of roll *4* and r_4 is the radius of roll *4*.

3434	FRICTION-LEVER MECHANISM OF A FLEXIBLE-LINK INTEGRAPH	CF MO



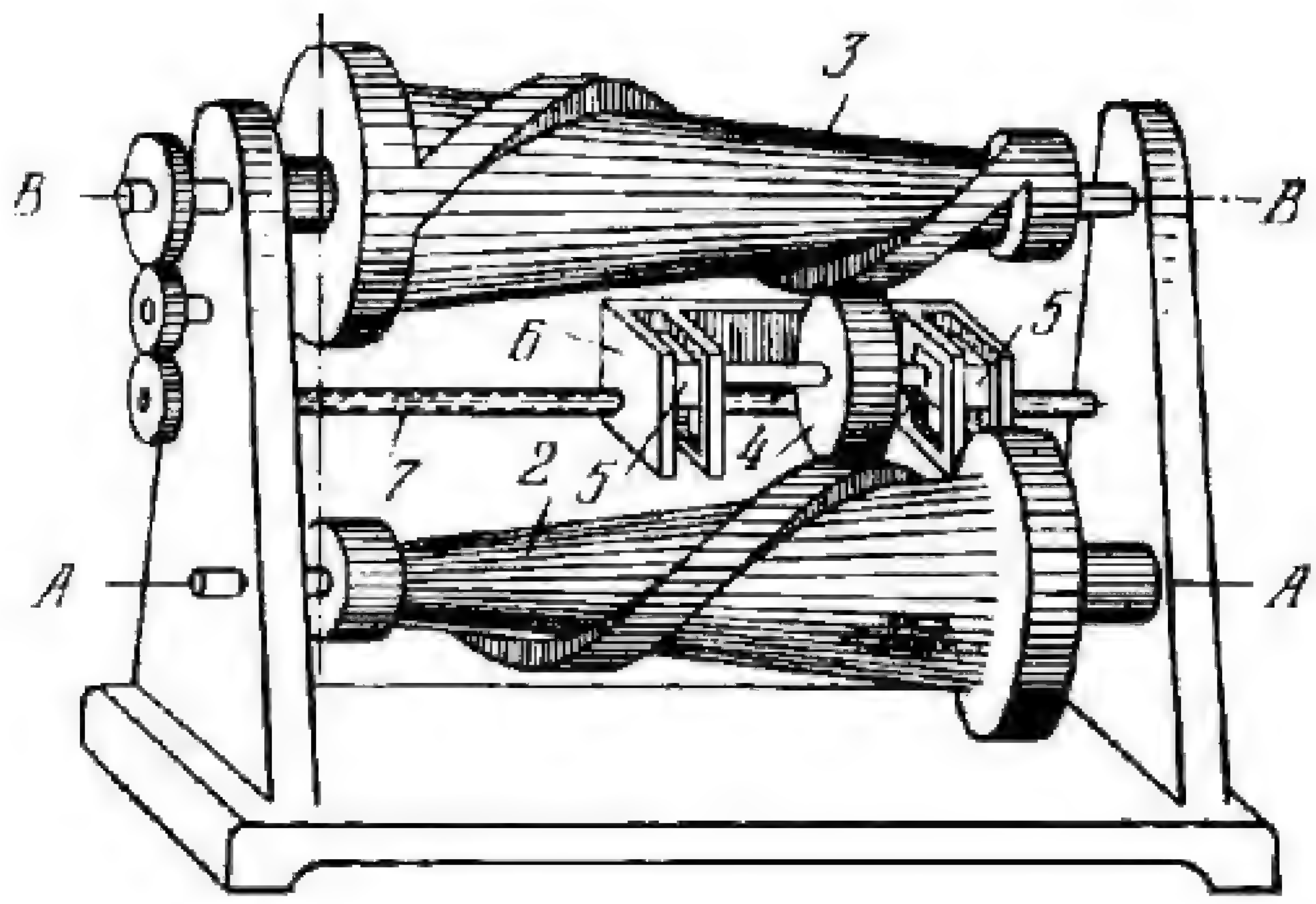
Carriage *1* travels along axis *x-x*. When tracing point *A* is moved along curve $y = f(z)$, slider *2* moves along a guide of carriage *1*. The movement of slider *2* is transmitted through flexible link *3* and slider *4* to tracing point *D* which gives the differential $\frac{dz}{dx} = f(z)$. Slotted guide link *5* turns about point *D* and simultaneously slides along block *6* which is pivoted to carriage *1* at point *B*. The motion of link *5* is transmitted through sleeve *7* and parallelogram linkwork *EKFN* to wheel *8* with a sharp-edged rim, the plane of the wheel being always parallel to link *5*. Wheel *8* is set so that the angle φ between its plane and axis *x-x* is such that

$$\tan \varphi = \frac{dz}{dx} = f(z).$$

By means of friction, wheel *8* moves table *9*, resting on the wheel, on which the curve $y = f(z)$ is drawn. At this, tracing point *M*, secured to table *9*, describes the curve

$$z = \int f(z)\, dx.$$

3435	**FRICTION-TYPE LOGARITHMIC FUNCTION GENERATOR**	CF MO

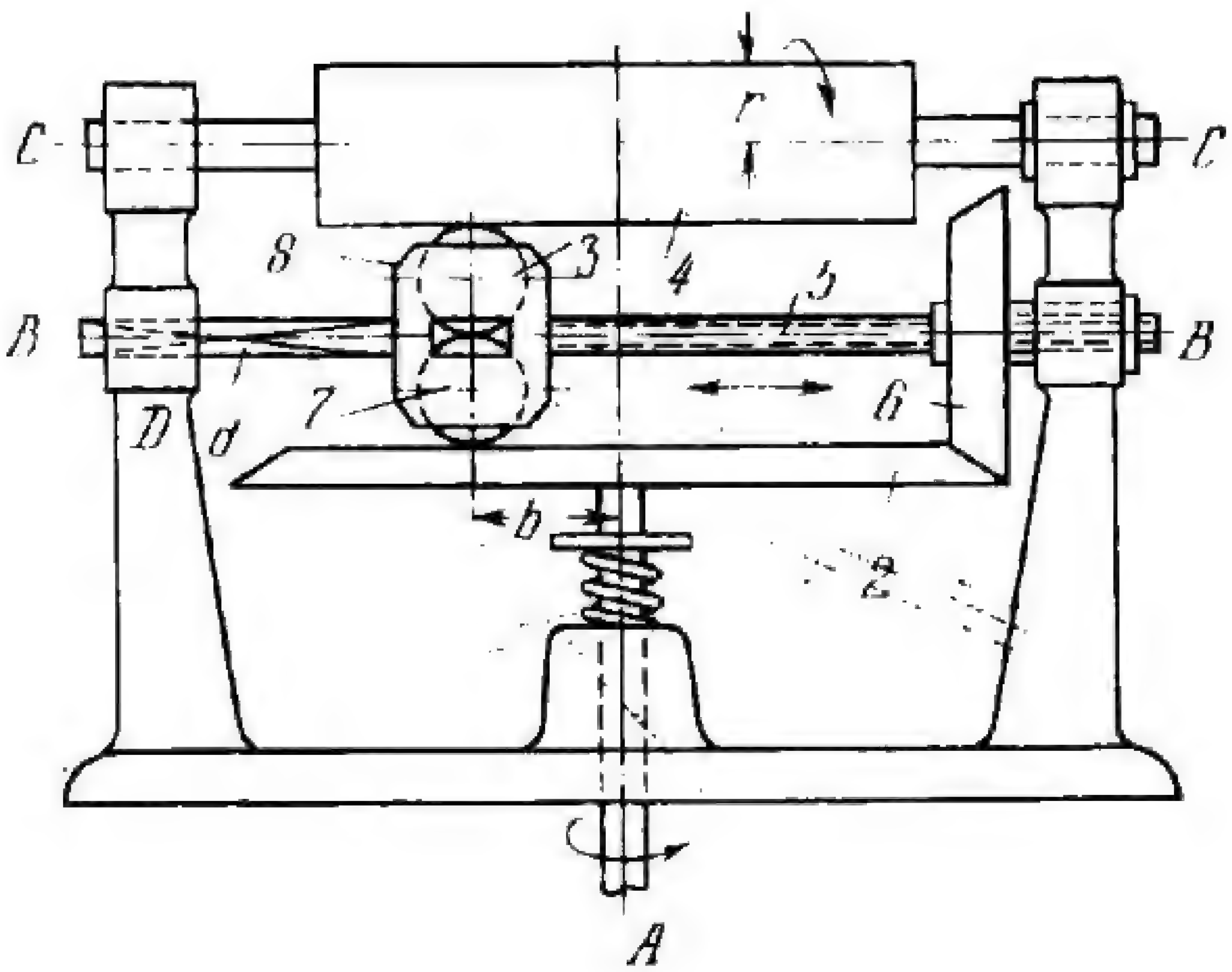


The speed of driven link *2*, rotating about fixed axis *A-A*, is an aperiodic function of the rotation of wheel *3* about fixed axis *B-B*, i.e. the required motion of link *2* can be obtained only for a certain range of values of the angle of rotation of driving link *3*. The axis of link *4* has plane translational motion which depends upon the angle of rotation of the driving link. Intermediate wheel *4* rotates about an axle mounted in slide-blocks *5* which can move perpendicular to the axes of the wheels in a plane parallel to these axes. Slide-blocks *5* slide in the guides of link *6* which is traversed by screw *7* parallel to the axes of the wheels a distance proportional to the angle of rotation of the driving link. Screw *7* is driven through a train of gears from link *3*. Motion is converted according to the equation

$$\beta = \log (1 + 10\alpha) + m\alpha$$

where α is the angle of rotation of the driving link, β is the angle of rotation of the driven link and m is a positive constant.

FRICTION-TYPE SQUARING MECHANISM



Bevel friction wheel *2* rotates about fixed axis A and engages bevel friction wheel *6* which rotates about fixed axis B-B. Wheel *6* is connected by a screw pair to link *5* on which carriage *8* is rigidly mounted. Carriage *8* is the cage of balls *3* and *7*. Link *5* has translational motion with its square shank d in fixed guide D. Ball *3* engages roll *4* which rotates about fixed axis C-C and ball *7* engages wheel *2*. By means of wheel *6* and screw *5*, carriage *8*, the cage of balls *3* and *7*, has a motion which is a function of the rotation of wheel *2*. The mathematical relationship accomplished by the mechanism is of the form:

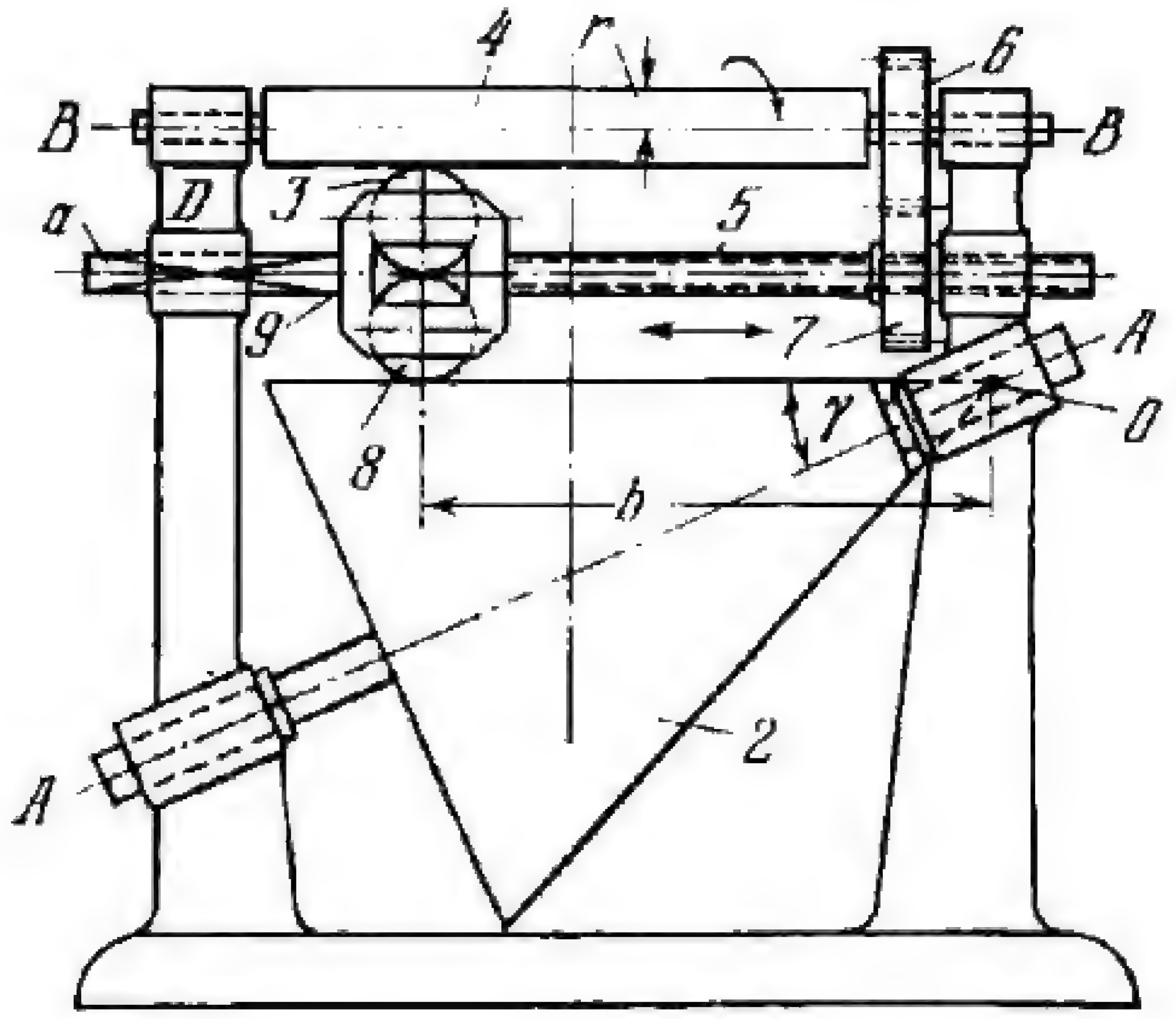
$$\alpha_4 = c' (\alpha_2 - \alpha_{20})^2 + c'' (\alpha_2 - \alpha_{20}) + \alpha_{40}$$

where

$$c' = \frac{i_{62}}{4\pi} \frac{h}{r} \qquad c'' = \frac{b_0}{r}$$

h is the pitch of screw *5*, i_{62} is the transmission ratio between wheels *6* and *2*, α_2 and α_4 are the angles of rotation of wheel *2* and roll *4*, and α_{20} and α_{40} are the initial angles of rotation of wheel *2* and roll *4*. The constant parameters of the mechanism are chosen so that $c' = 1$ and $c'' = 0$. If, in addition, it is assumed that $\alpha_{20} = \alpha_{40} = 0$, then the quantity α_4 equals the square of scalar α_2.

3437	FRICTION-TYPE LOGARITHMIC FUNCTION GENERATOR	CF MO

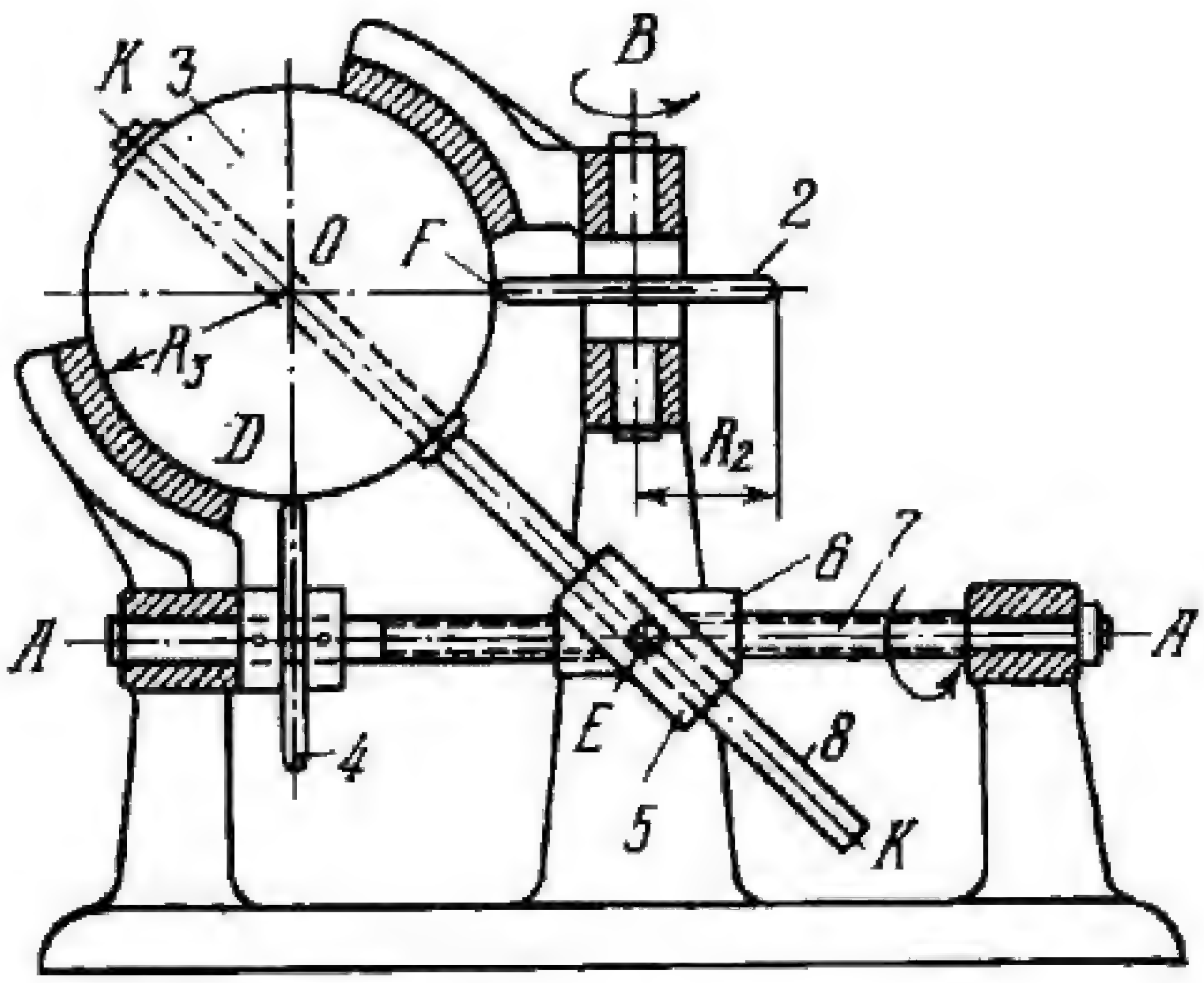


Friction cone *2* rotates about fixed axis *A-A* and engages ball *8* which is held in cage (carriage) *9*. Carriage *9* is rigidly mounted on screw *5* and its square shank *a* slides axially with the screw in fixed guide *D*. Roll *4* rotates about fixed axis *B-B*. Gear *6* is keyed to roll *4* and meshes with gear *7* which is connected by a screw pair to screw *5*. Rotation of roll *4* traverses screw *5* with cage *9*, holding balls *3* and *8*. Ball *3* engages roll *4* and, through ball *8*, causes friction cone *2* to rotate. The mathematical relationship accomplished by the mechanism is of the form:

$$\alpha_2 = \alpha_{20} + \frac{1}{c} \ln \frac{c(\alpha_4 - \alpha_{40})}{c'} + c'$$

where $c = \frac{i_{67} h \sin\gamma}{2\pi r}$, $c' = \frac{b \sin\gamma}{r}$, α_2 is the angle of rotation of wheel *2*, α_{20} is the initial angle of rotation of wheel *2*, α_4 is the angle of rotation of roll *4*, α_{40} is the initial angle of rotation of roll *4*, i_{67} is the transmission ratio between gears *6* and *7*, h is the pitch of screw *5*, b is the coordinate of the initial point of contact of ball *8* with reference to the apex of cone *2*, and r is the radius of roll *4*.

3438	FRICTION-TYPE LOGARITHMIC FUNCTION GENERATOR	CF MO



Friction wheel *2* is driven by friction wheel *4* through ball *3*. Ball *3* rotates about axis *K-K* on shaft *8* which can slide axially in sleeve *5*. Sleeve *5* is connected by turning pair *E* to nut *6* which is connected by a screw pair to screw *7*. Wheel *4* is keyed to screw *7*, rotates about fixed axis *A-A* and engages ball *3* at point *D*. By rotating screw *7*, nut *6* can be traversed axially, changing the axis of rotation *K-K* of the ball which engages wheel *2* at point *F*. Wheel *2* rotates about fixed axis *B*. The radii R_2 and R_4 of wheels *2* and *4* are equal. The angles of rotation, φ_2 and φ_4, of wheels *2* and *4* are related by the condition:

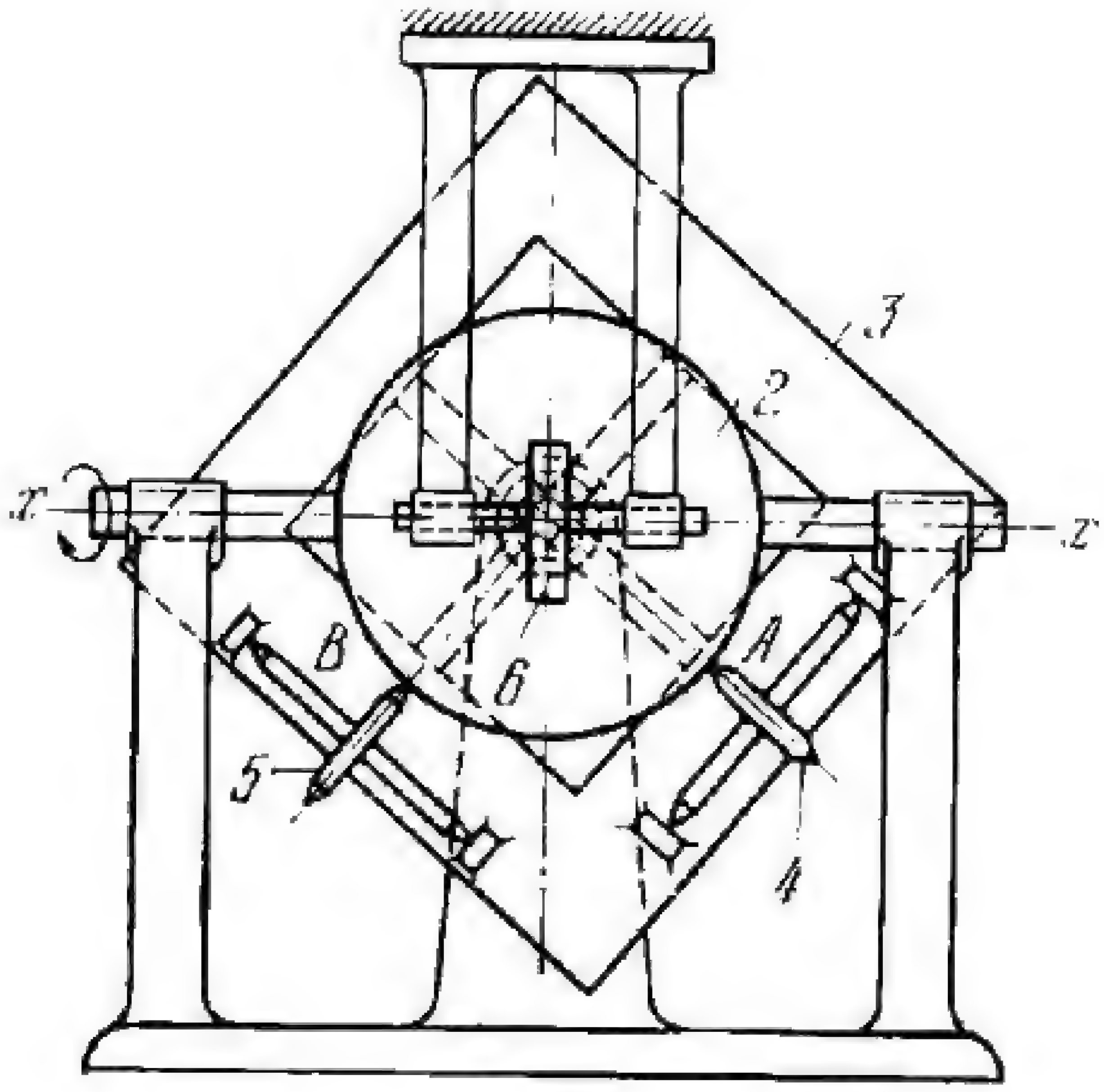
$$\varphi_2 - \varphi_{20} = c \ln (\varphi_4 - \varphi_{40})$$

where φ_{20} and φ_{40} are the initial angles of rotation of wheels *2* and *4*, c is a constant equal to

$$c = \frac{R_3 + R_2}{r \tan \beta}$$

where R_2 and R_3 are the radii of wheel *2* and ball *3*, r is the pitch radius of the thread of screw *7* and β is the helix angle of this thread.

3439	FRICTION-TYPE HARMONIC ANALYZER MECHANISM	CF MO



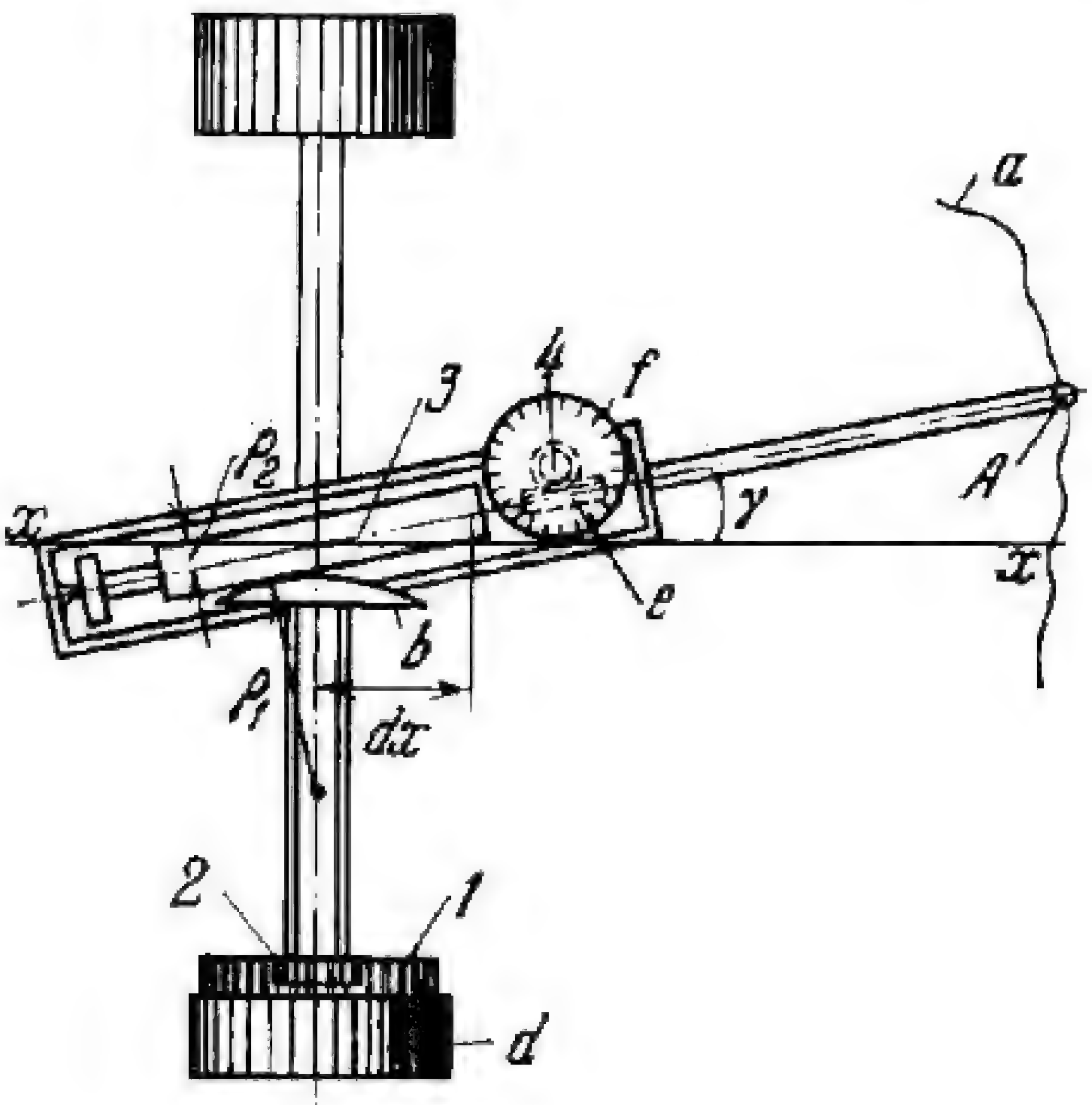
Ball *2* is driven by friction by wheel *6* and rotates about fixed axis *x-x*. Yoke *3* rotates about an axis passing through the centre of the ball and perpendicular to the plane of the drawing. Owing to friction, wheels *4* and *5* are rotated by ball *2*. The angle of rotation of friction wheel *6* is proportional to the function $y = f(\alpha)$ being analyzed, and the motion of the ball is determined by the equation $\alpha_2 = p_2 y$, where α_2 is the angle of rotation of the ball and p_2 is the proportionality factor. Without slippage at points *A* and *B*, yoke *3* is rotated an amount corresponding to $q\alpha$. The angles of rotation of wheels *4* and *5* for q whole revolutions of the yoke are

$$\alpha_4 - \alpha_{40} = \frac{R_2 p_2}{R_4} \int_{\alpha=-\pi}^{\alpha=+\pi} \sin q\alpha \, dy = A_q$$

$$\alpha_5 - \alpha_{50} = \frac{R_2 p_2}{R_5} \int_{\alpha=-\pi}^{\alpha=+\pi} \cos q\alpha \, dy = B_q$$

where A_q and B_q are the constant coefficients of a Fourier series for the given periodic function $y = f(\alpha)$, and R_2, R_4 and R_5 are the radii of ball *2* and wheels *4* and *5*.

3440	FRICTION-GEAR PLANIMETER MECHANISM	CF MO

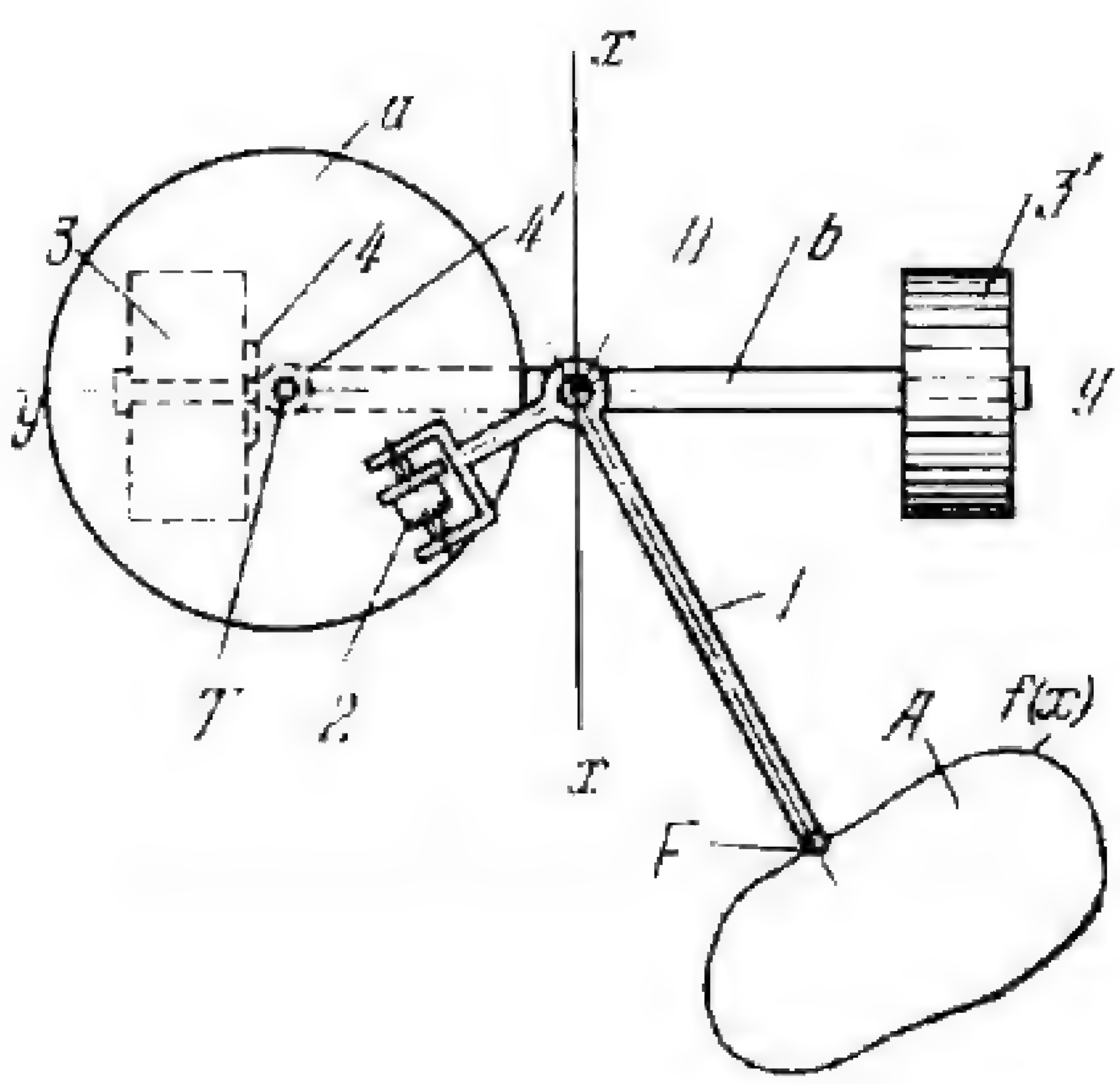


When tracing point A is moved along curve a, the planimeter travels along axis x-x and gear 1, rigidly attached to guide roller d, turns pinion 2. Rotation is transmitted from pinion 2 by means of spherical segment b to roll 3. Roll 3 is rigidly attached to worm e which transmits rotation further to worm wheel 4 and recording wheel f. The rotation of roll 3, indicated by recording wheel f, is proportional to integral K which equals

$$K = \frac{\rho_1}{2\pi r \rho_2} \int dx \sin \gamma$$

where ρ_1 and ρ_2 are the radii of segment b and roll 3.

3441	FRICTION-GEAR MECHANISM OF A DISK AND ROLLER PLANIMETER	CF MO

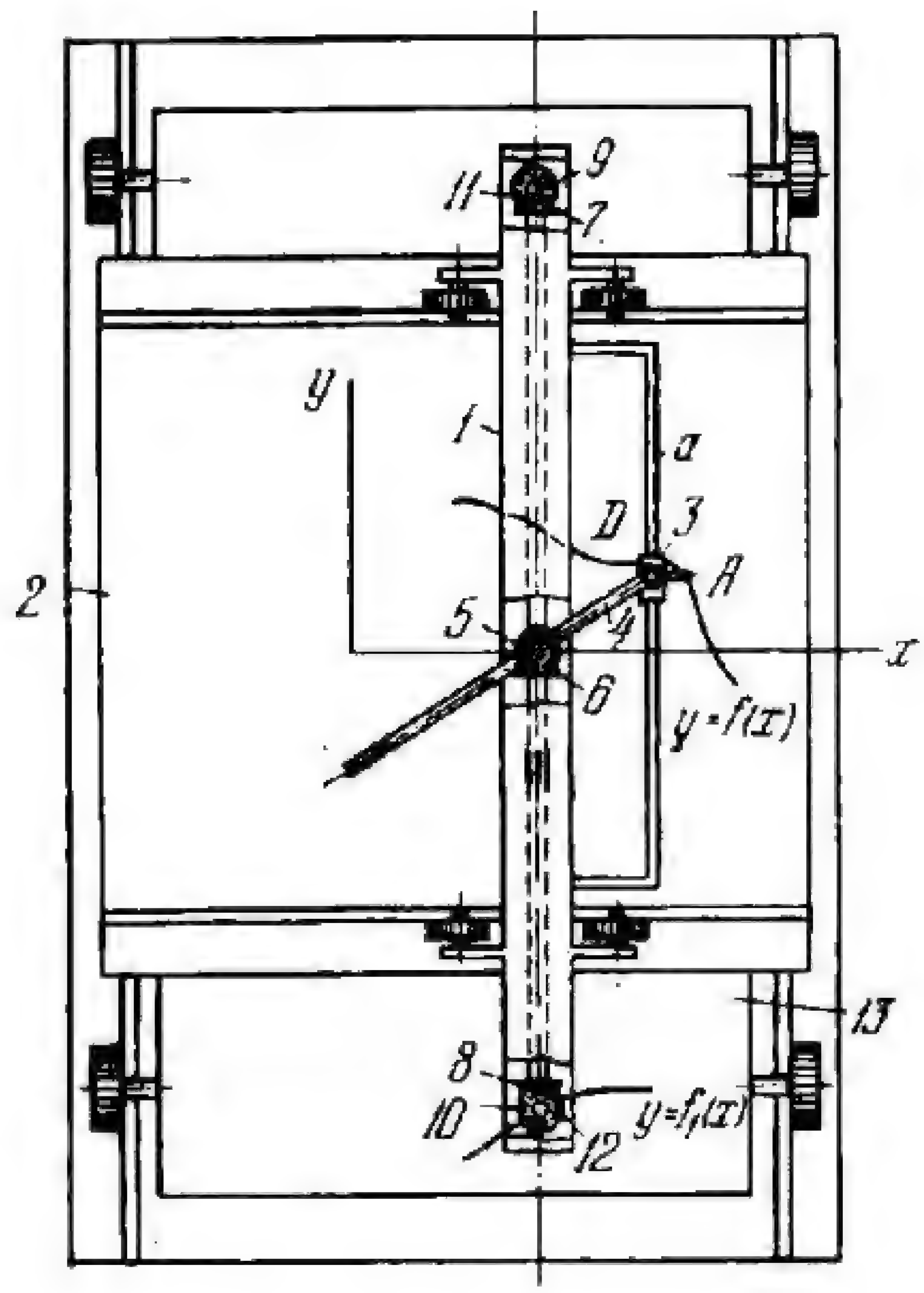


When tracing point F is moved along curve $y = f(x)$, guide rollers *3* and *3'*, connected by link b, travel along axis x-x. Attached to roller *3* is gear *4* which meshes with gear *4'*, rotating about axis T of link b. Rigidly attached to gear *4'* is disk a along which recording wheel *2* rolls. The angle of rotation α of wheel *2* is proportional to the area A of the figure around which point F has been traced:

$$\alpha = cA = c \oint f(x)\, dx.$$

When lever *1* is turned about point D, wheel *2* does not turn about its axis.

3442	FRICTION-GEAR MECHANISM OF A DIFFERENTIO-INTEGRAPH	CF MO



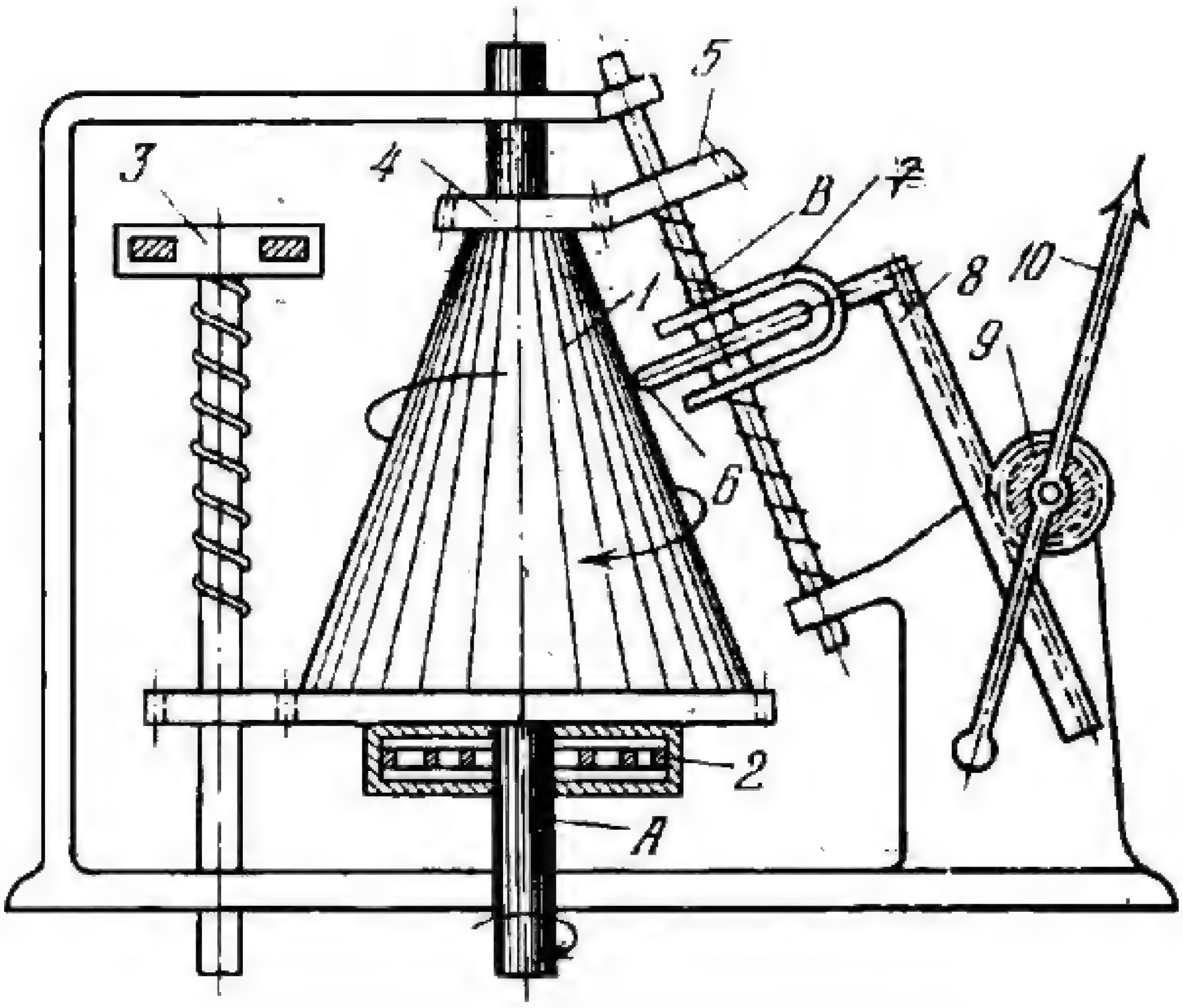
When tracing point A is moved along curve $y = f(x)$, carriage *1* travels along axis x on fixed guide 2 and slider *3* travels on guide a along axis y. At the same time, sliding link *4* turns about axis D and slides in a slot of disk *5*. When link *4* turns, disk *5* is turned with its rigidly attached bevel gear, also turning bevel gear *6* which is keyed to a shaft together with bevel gears *7* and *8*. Rotation is transmitted from gears *7* and *8* to gears *9* and *10* to which wheels *11* and *12* with sharp-edged rims are attached (shown by dash lines). Thus, in any position, wheels *11* and *12* are always parallel to sliding link *4*. Owing to friction, rotation of wheels *11* and *12* causes carriage *13* to move along axis y and the point of support (bearing) of wheel *12* to trace the integral curve

$$y = \frac{1}{p} \int f(x)\,dx = f_1(x).$$

If the point of support of wheel *12* is moved along curve $y = f_1(x)$, tracing point A traces the curve of the differential of the function.

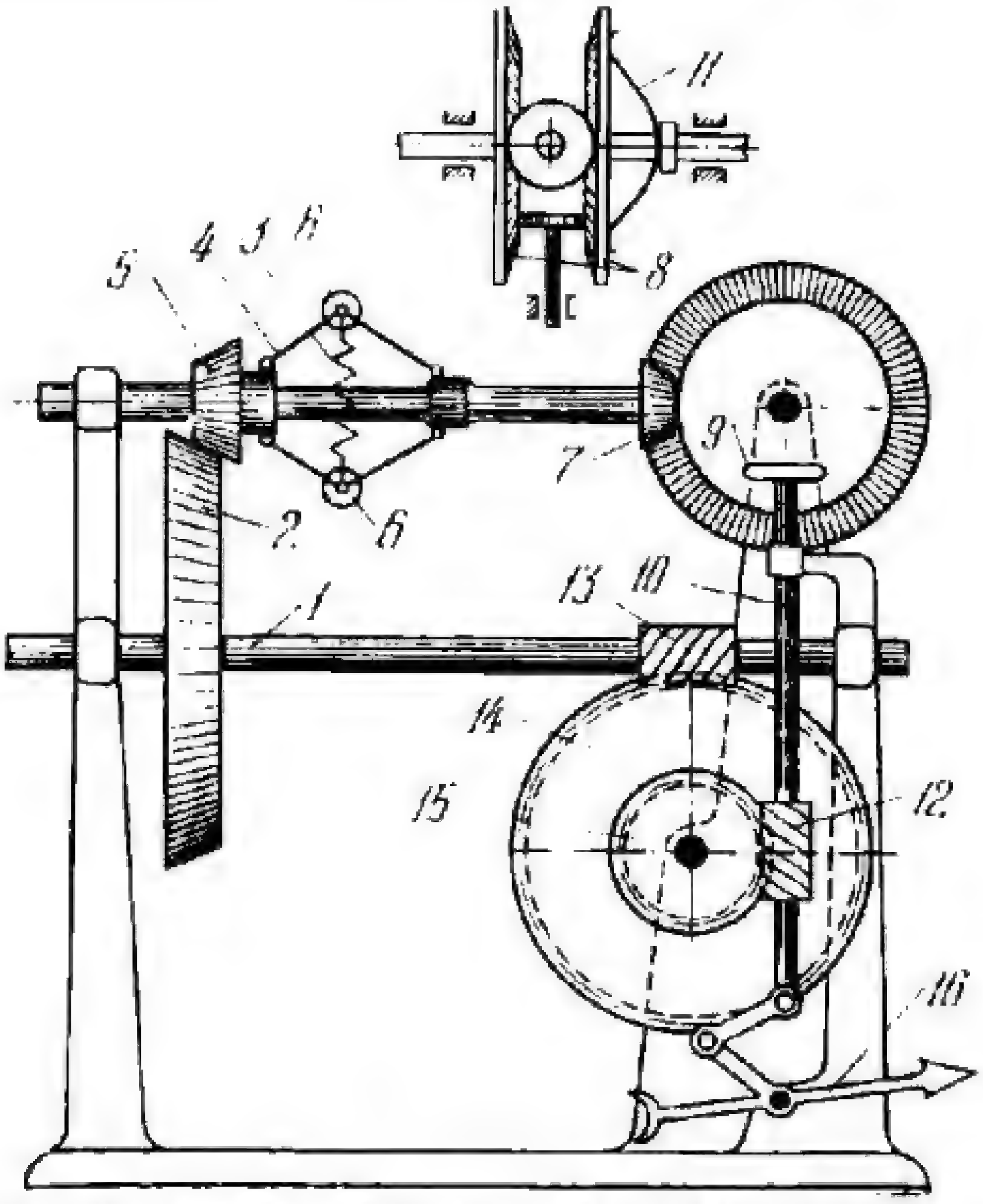
4. MECHANISMS OF MEASURING AND TESTING DEVICES (3443, 3444 and 3445)

3443	FRICTION-TYPE TACHOMETER MECHANISM	CF M



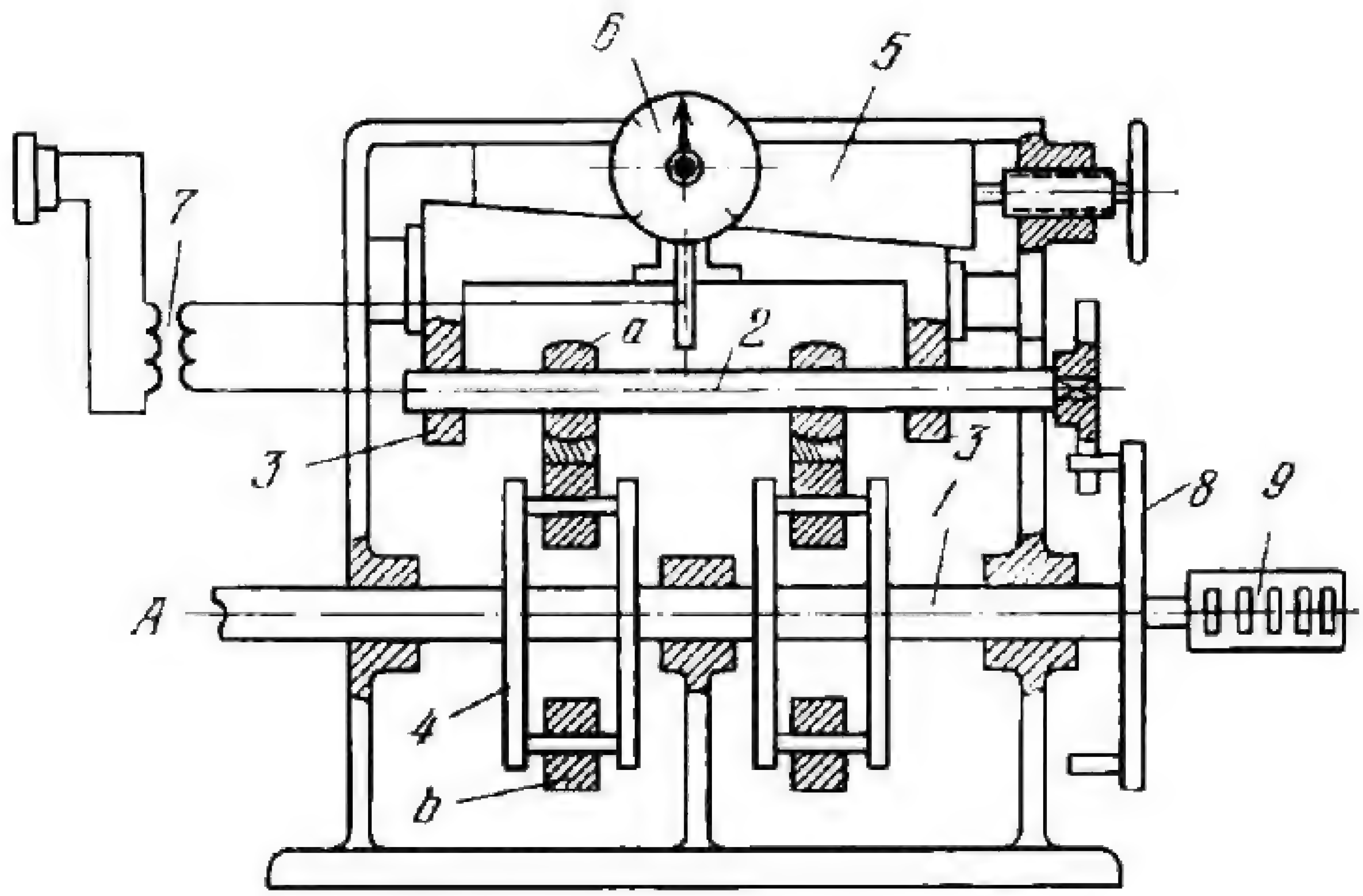
Shaft *A* is driven by the shaft whose speed is to be measured and, through friction clutch *2*, shaft *A* rotates cone *1*. Cone *1* is connected by gearing to centrifugal governor *3* which maintains constant speed of the cone. Shaft *B* is driven from shaft *A* through bevel gears *4* and *5*, and has a helical thread along which friction wheel *6* can be traversed. The peripheral speed of wheel *6* at its point of contact with cone *1* is equal to the peripheral speed of the cone. If the angular velocities of wheel *6* and cone *1* differ, wheel *6* will be moved along shaft *B* until they are the same. The movement of friction wheel *6* is transmitted by fork *7* to gear rack *8* which meshes with pinion *9* of hand *10*. The hand indicates the speed of shaft *A* and of the shaft whose speed is being measured.

3444	FRICTION-GEAR CENTRIFUGAL TACHOMETER MECHANISM	CF M



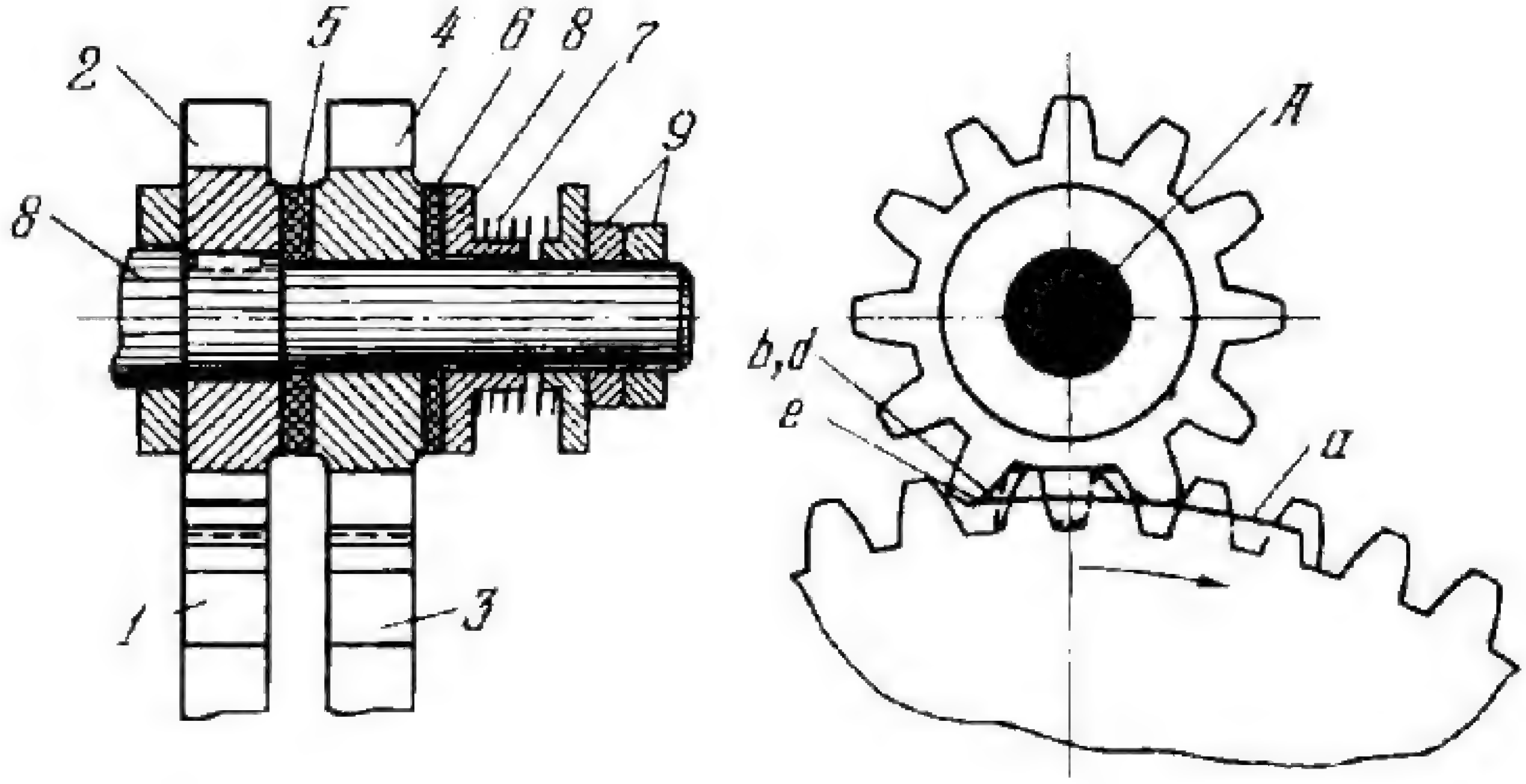
Shaft *1*, on which tapered friction disk *2* is keyed, is driven by the shaft whose speed is to be measured. Tapered disk *5* is pressed against disk *2* by spring *3* of governor *4*. This drives the governor. When the governor reaches a definite speed, the centrifugal force of balls *6* overcomes the resistance of spring *3*, withdrawing wheel *5* from wheel *2*. Thus the speed of the governor shaft never exceeds a certain constant speed, regardless of the speed of the shaft being tested. Bevel gear *7* meshes with bevel gears *8* between which roller *9*, keyed to shaft *10*, is located. The two gears *8* are pressed against roller *9* by spring *11* and drive it at a speed which corresponds to the distance from the plane of the roller to the axis of rotation of the gears. Worm *12* meshes with worm wheel *15* which is driven from shaft *1* through worm *13* and worm wheel *14*. The hands of worms *12* and *13* are such that when the tachometer is switched on, worm wheel *15* tends to shift shaft *10* downward, and roller *9* tends to shift it upward by screwing worm *12* "out" of worm wheel *15*. The whole system and hand *16* come to equilibrium when roller *9* is at the position with respect to the axis of gears *8* in which the velocity of the raising of shaft *10* from the rotation of roller *9* equals the velocity of the lowering of the shaft from the rotation of worm wheel *15*. The higher the speed of the shaft being tested, the lower roller *9* should be with respect to the axis of gears *8* to achieve equality of the two motions of shaft *10* and, consequently, the greater the angle through which speed indicator hand *16* turns in the counterclockwise direction.

3445	FRICTION-TYPE MECHANISM FOR DYNAMIC BENDING TESTS	CF M



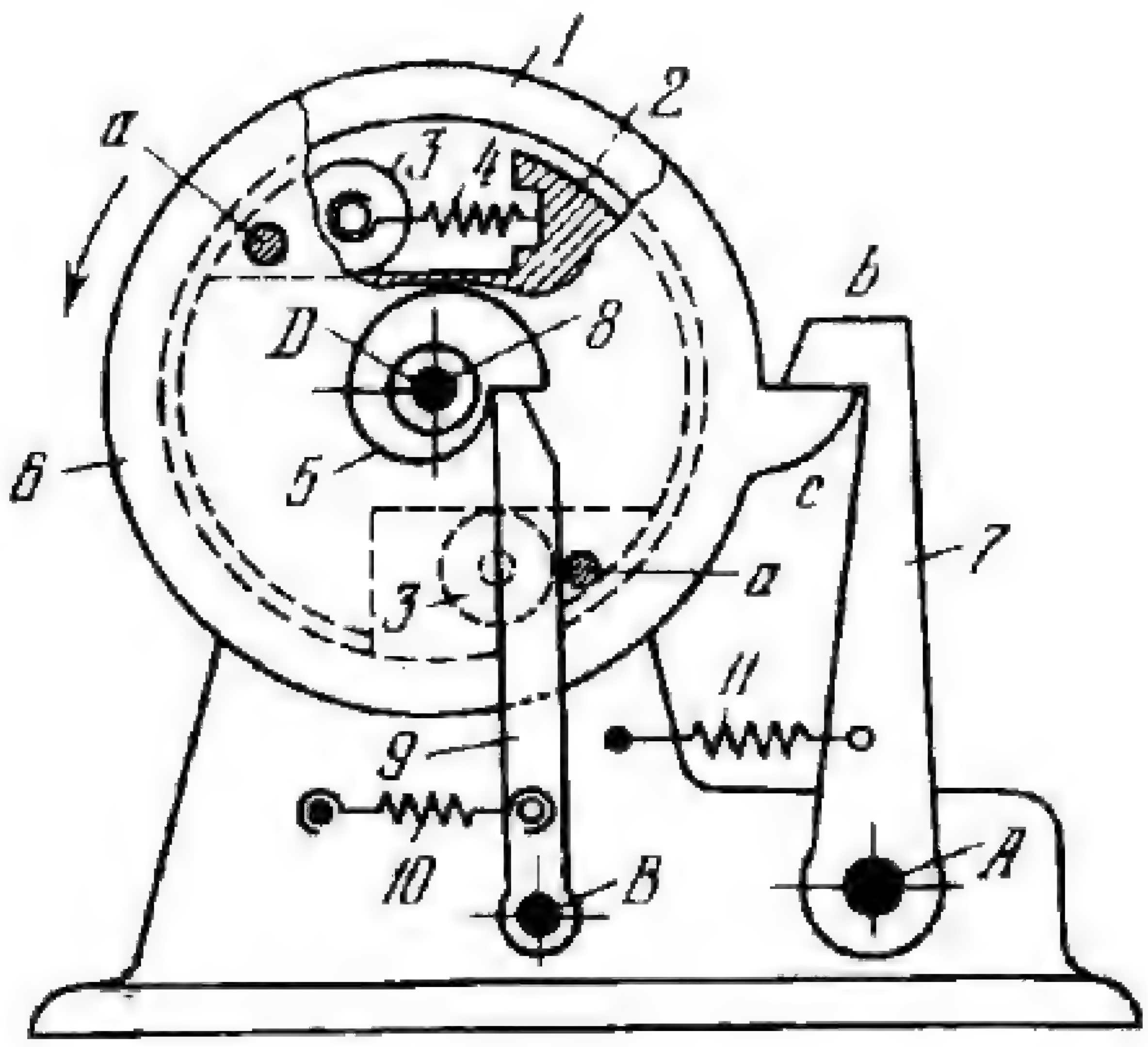
Bar *2*, being tested, is mounted in bearings *3* and is fitted into spherical members *a*. Driving shaft *1* rotates about fixed axis *A* and carries holders *4* with rollers *b* which act on members *a*. As each pair of rollers *b* passes under bar *2*, the latter is bent upward. Bearings *3* can be adjusted vertically by wedge *5*. Instrument *6* indicates the bending deflection of bar *2*. Electrical device *7* indicates the instant of contact between bar *2* and instrument *6*. Pin wheel *8* turns bar *2* through 90° between consecutive blows. Counter *9* indicates the number of revolutions bar *2* makes up to its failure.

3446	FRICTION-DRIVEN MECHANISM FOR SHOCKLESS INTERMITTENT GEARING	CF D



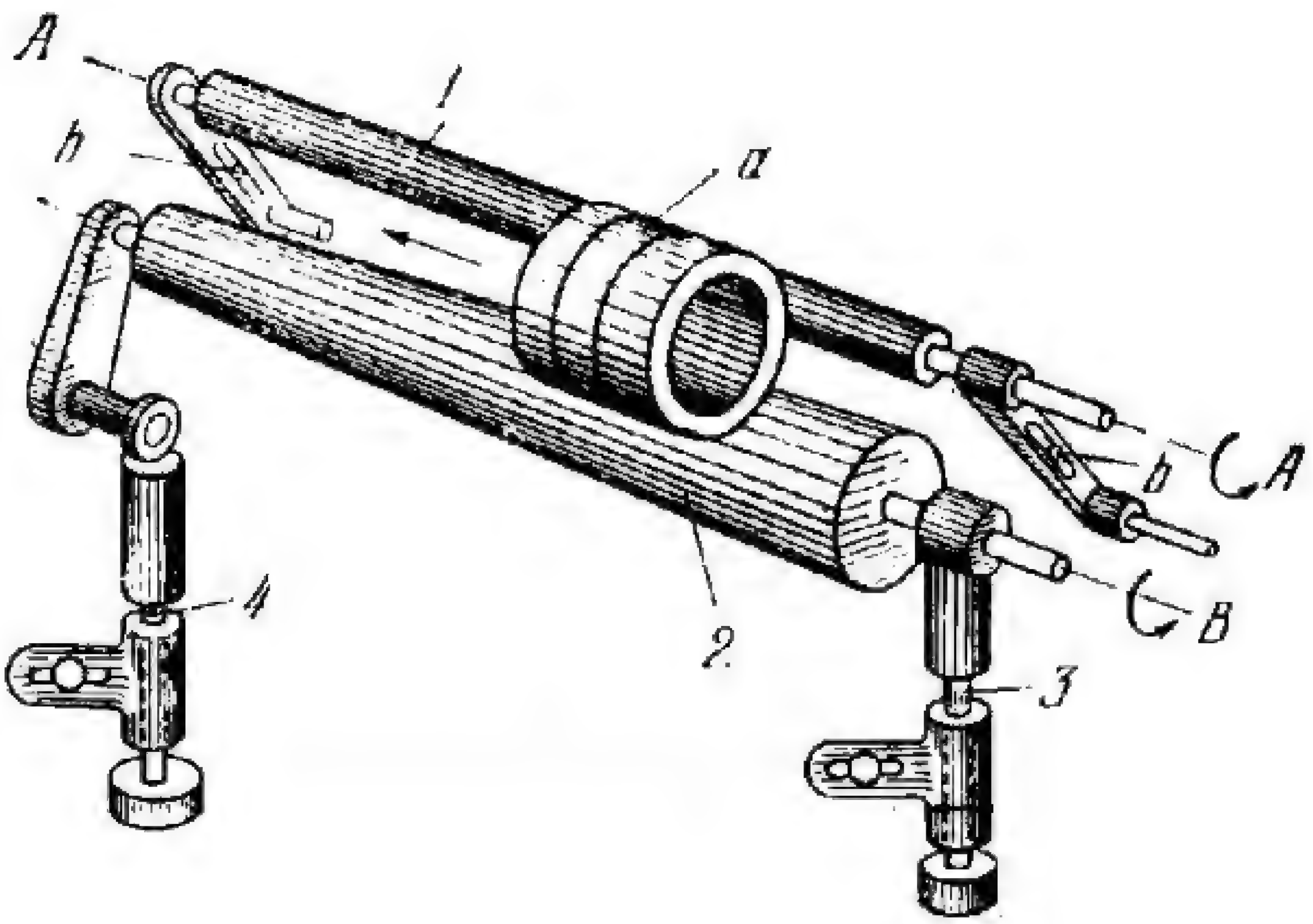
Intermittent gear *1* and gear *3* are keyed to the driving shaft (not shown) and mesh with gears *2* and *4*. Gear *2* is keyed to driven shaft *8*, rotating about fixed axis *A*, and gear *4* is free to turn on this shaft, being mounted between friction washers *5* and *6* which, in turn, are between gear *2* and disk *8*. The pressure of washers *5* and *6* against gear *4* can be varied by adjusting lock-nuts *9*, thereby changing the tension of spring *7*. Friction washers *5* and *6* tend to transmit rotation to the driven shaft. During the dwell period, gear *2* is stationary and gear *4* slips with respect to shaft *8*. At the end of the dwell period, when point *b* of surface *a* on gear *1* has passed point *d* of surface *e* on gear *2* (as shown), shaft *8* begins to rotate due to the action of gears *3* and *4* and the friction drive, before the teeth of gears *1* and *2* come into contact. Thus rotation of shaft *8* is started smoothly, with no shock, after the dwell period.

3447	FRICTION-LEVER DWELL MECHANISM	CF D



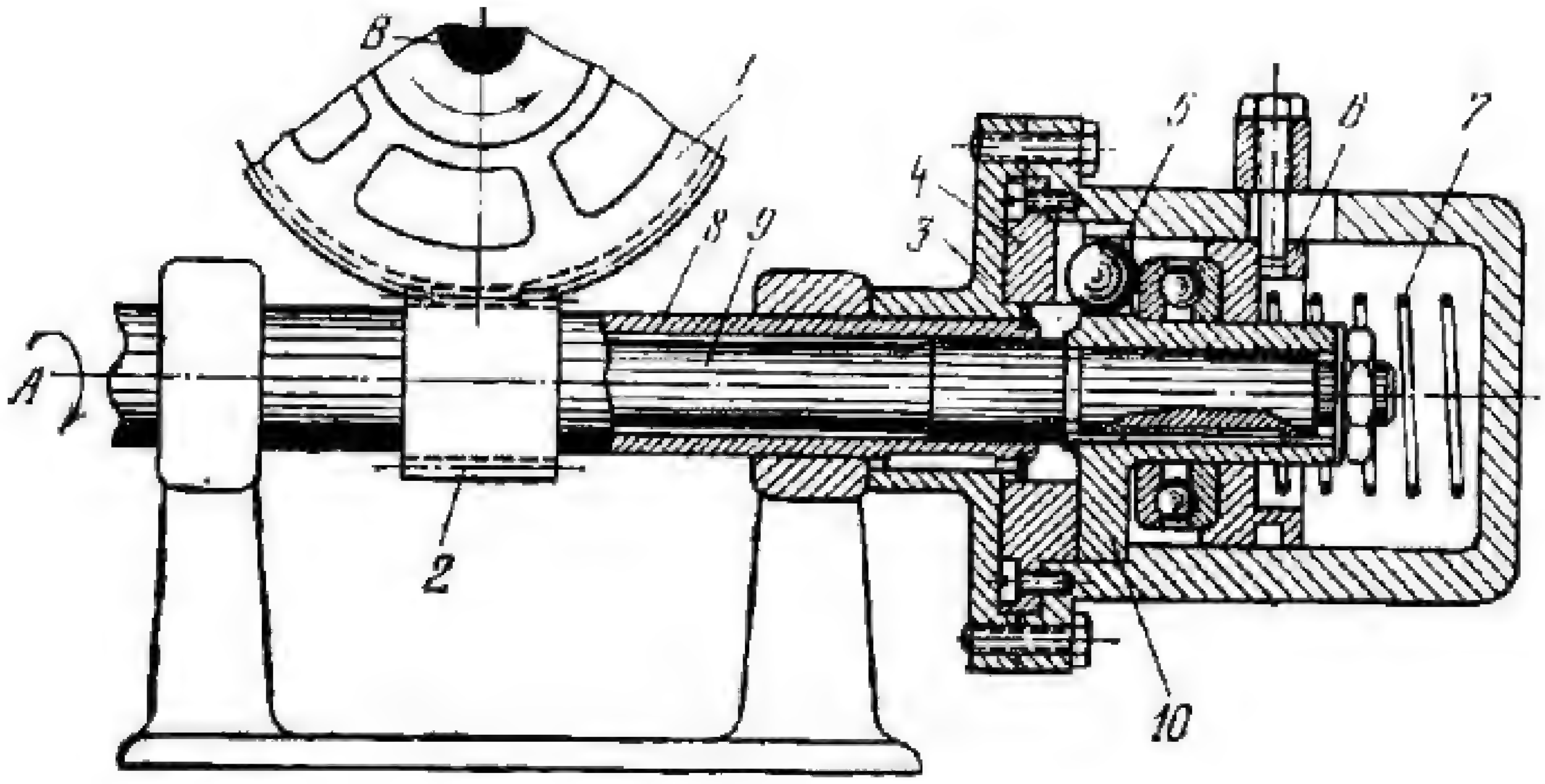
Drum *1* rotates continuously about fixed axis *D* and has a common geometrical axis with driven disk *2*. Slots in disk *2* contain balls *3* which are subject to the action of compression springs *4* and are prevented from jamming between drum *1* and disk *2* by pins *a* which are mounted in disk *6*. Disk *6* rotates freely about shaft *8* and is restricted against rotation by lug *b* of starting lever *7* which turns about fixed axis *A*. When starting lever *7* is momentarily turned clockwise, compression springs *4* push balls *3* so that they jam between disk *2* and drum *1*, engaging them so that disk *2* begins to rotate. At the end of one revolution, lug *c* of disk *6* engages lug *b* of lever *7* which has returned to its initial position. At this, pins *a* disengage disk *2* from drum *1*. Reverse rotation of disk *6* is prevented by cam *5* and pawl *9* which turns about fixed axis *B*. Pawl *9* and lever *7* are held in contact with cam *5* and disk *6* by springs *10* and *11*.

3448	FRICTION-TYPE RING FEEDING MECHANISM	CF SF



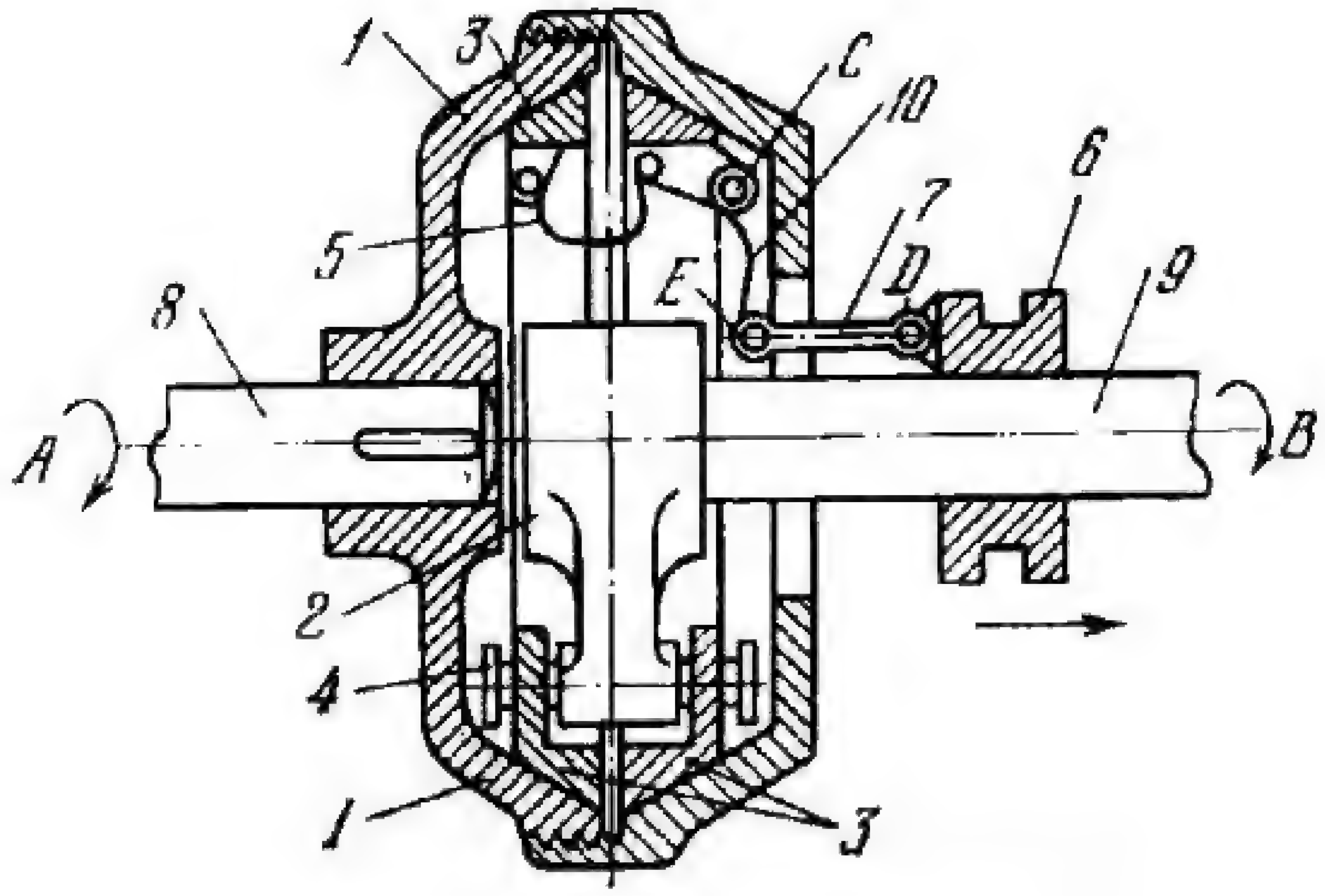
When shafts *1* and *2* rotate in the same direction, ring blanks *a*, which are to be ground, slide axially toward the grinding wheel. Pins *b* serve for rigidly setting cylindrical shaft *1*. Tapered shaft *2* is set up and adjusted by screw devices *3* and *4* (not shown in detail). Cylindrical shaft *1* rotates about fixed axis *A-A*, and tapered shaft *2* rotates about fixed axis *B* which is parallel to axis *A-A*.

3449	FRICTION-GEAR SAFETY CLUTCH MECHANISM	CF C



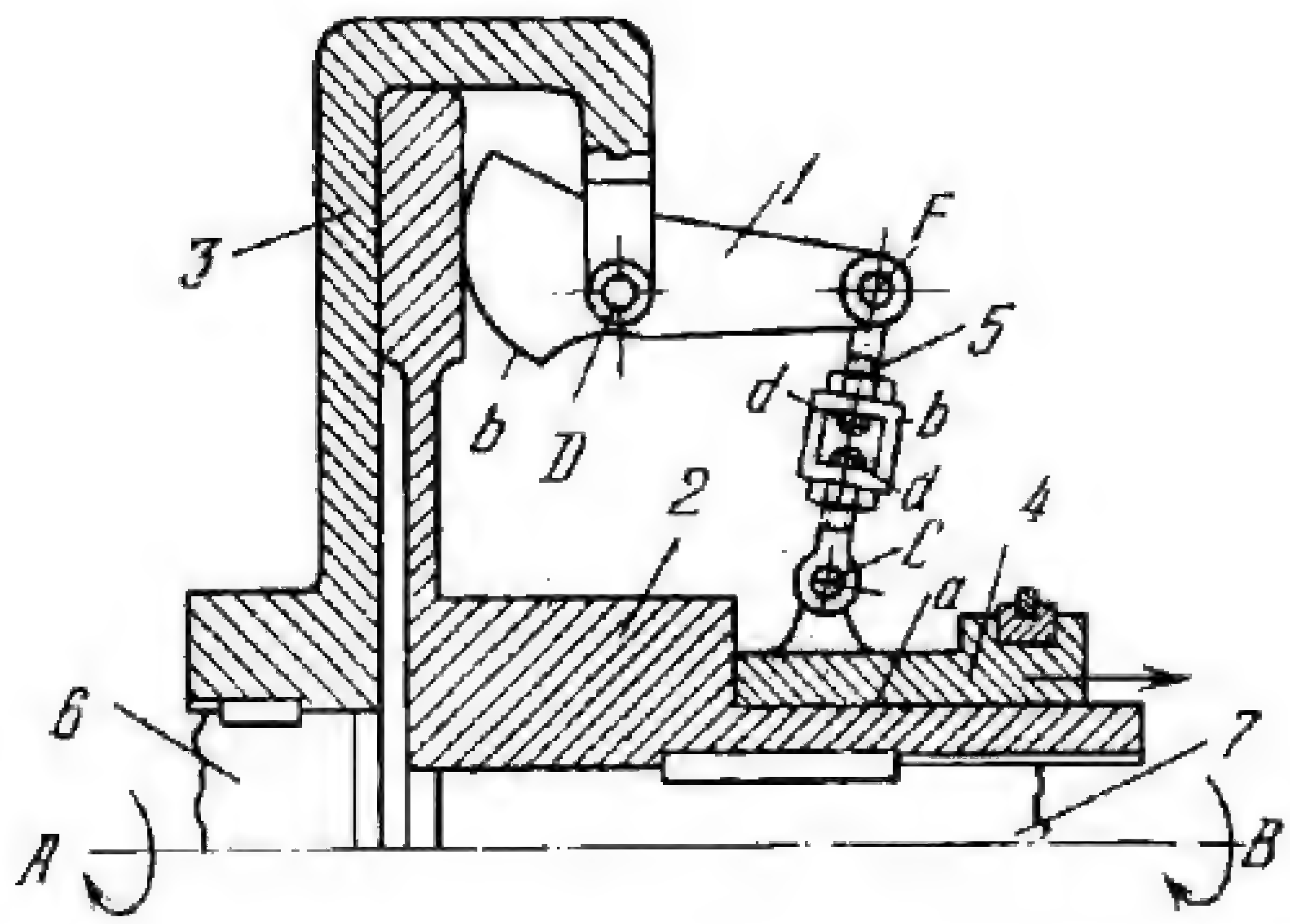
Worm wheel *1* rotates about fixed axis *B* and meshes with worm *2* which is keyed to hollow shaft *8* and rotates about fixed axis *A*. Driven shaft *9* rotates about axis *A* and is driven, at normal load, by means of flanges *3* and *4*, keyed to hollow shaft *8*, and balls *5* which are held in cage *10* and engage grooves in flange *4*. Cage *10* is keyed to driven shaft *9*. Balls *5* are held in the grooves by pressure member *6* and spring *7*. In case of overload, the balls are forced out of the grooves, compressing spring *7*, and shaft *9* stops until the torque load drops below the permissible value.

3450	FRICTION-LEVER SPRING-LINK CLUTCH MECHANISM	CF C



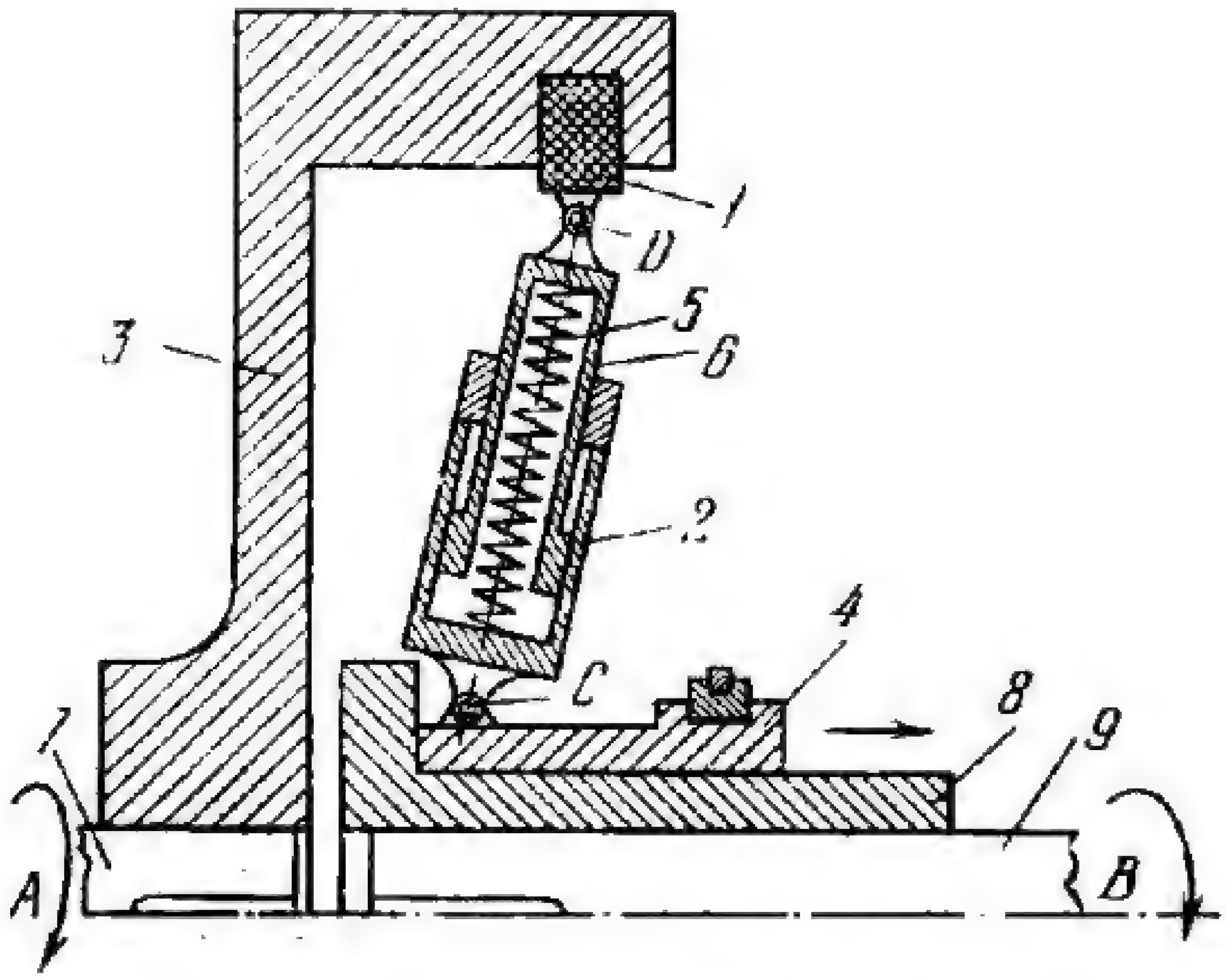
The clutch consists of housing *1*, keyed to shaft *8* and rotating about fixed axis *A*, and centre-piece *2*, keyed to shaft *9* and rotating about fixed axis *B*. On pins *4*, centre-piece *2* carries friction cones *3* which engage internal conical surfaces of housing *1*. Engaging collar *6* slides along shaft *9* and is connected by turning pair *D* to link *7* which, in turn, is connected by turning pair *E* to arm *10*. Arm *10* turns about axis *C* of centre-piece *2*. Cones *3* are pressed against housing *1* by spring *5*. The clutch is disengaged by shifting collar *6* to the right.

3451	FRICTION-LEVER CAM-TYPE CLUTCH MECHANISM	CF C



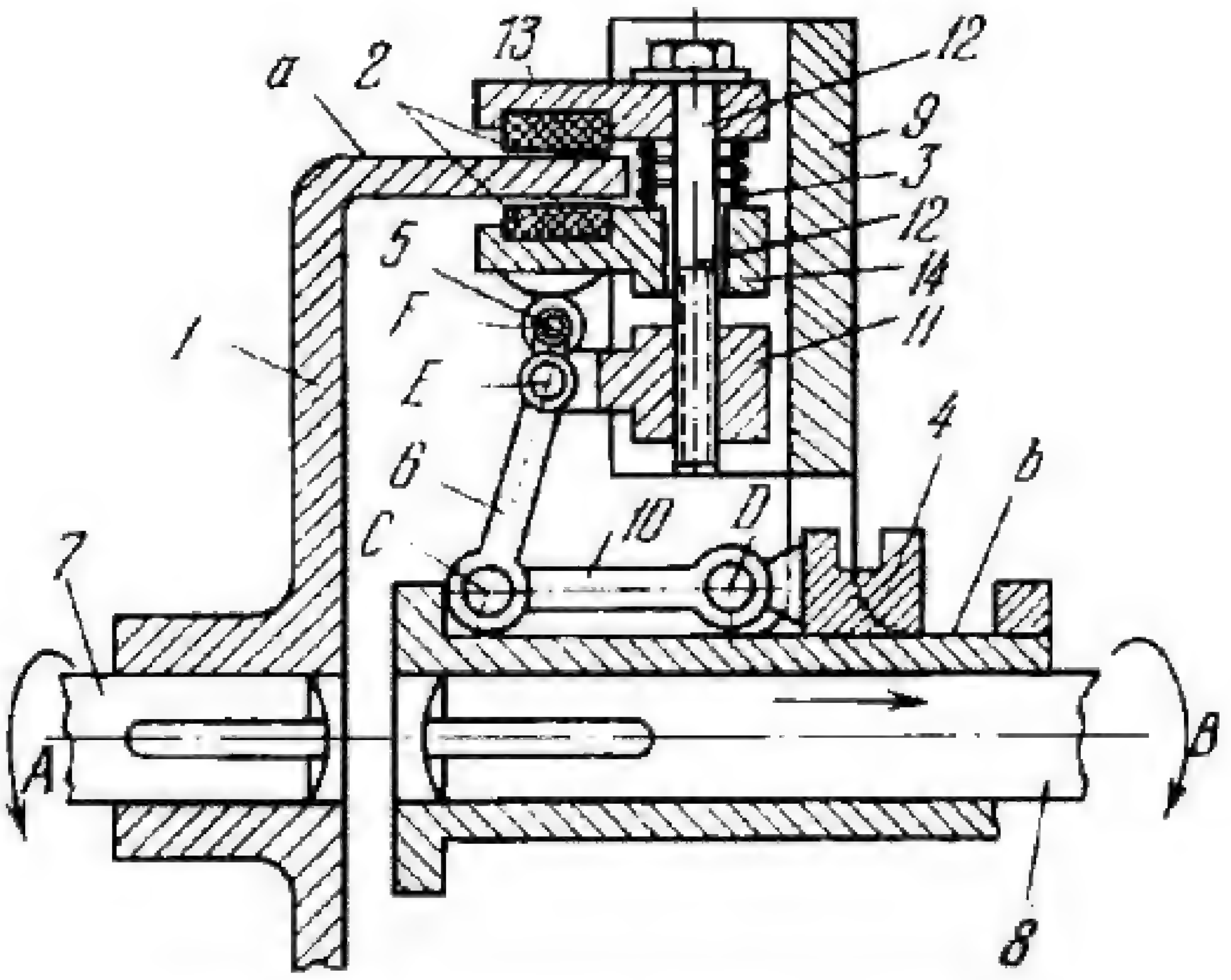
Link *3* of the clutch is keyed to shaft *6* and rotates about fixed axis *A*. Link *2* is keyed to shaft *7* and rotates about fixed axis *B*. Engaging collar *4* slides along guide *a* of link *2* and is connected by turning pair *C* to link *5* which consists of shackle *b* connected by screw pairs to screws *d*. Cam *1* turns about axis *D* of link *3* and is connected by turning pair *F* to link *5*. When collar *4* is shifted to its extreme left-hand position, working surface *b* of cam *1* presses the flange of link *2* against link *3*. The clutch is disengaged by shifting collar *4* to the right. The position of cam *1* with respect to collar *4* is adjusted by turning shackle *b* on screws *d* o lengthen or shorten link *5*.

3452	FRICTION-LEVER SPRING-LINK CLUTCH MECHANISM	CF C



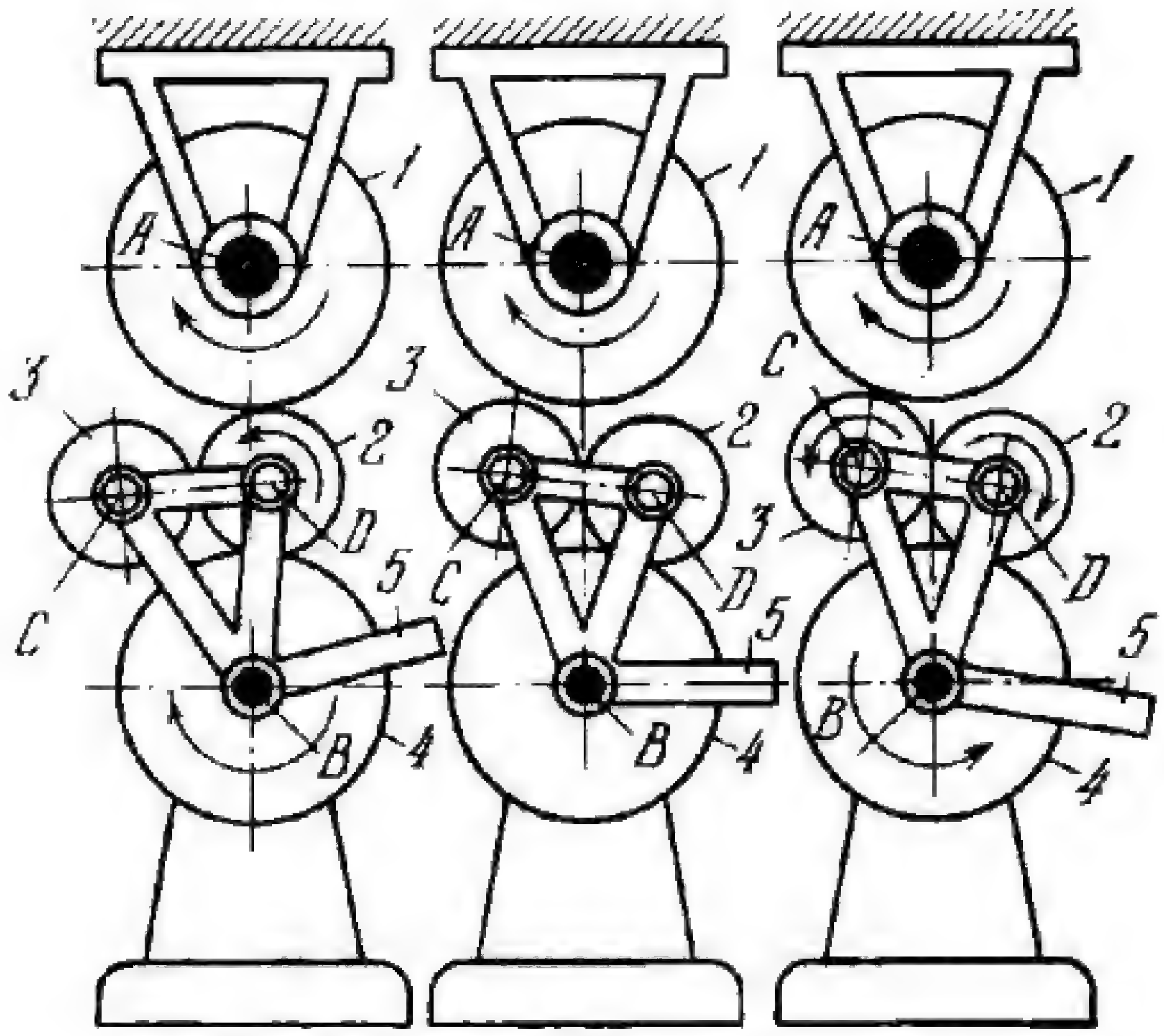
Link *3* of the clutch is keyed to shaft *7* and rotates about fixed axis *A*. Link *8* is keyed to shaft *9* and rotates about fixed axis *B*. Engaging collar *4* slides along link *8* and is connected by turning pair *C* to cylinder member *2* inside of which plunger *6* slides. Plunger *6* is connected by turning pair *D* to slide-block *1* which engages a groove in link *3*. Slide-blocks *1* are pressed against the surface of link *3* by springs *5* when collar *4* is shifted to its extreme left-hand position. The clutch is disengaged by shifting collar *4* to the right.

3453	FRICTION-LEVER CLUTCH MECHANISM	CF C



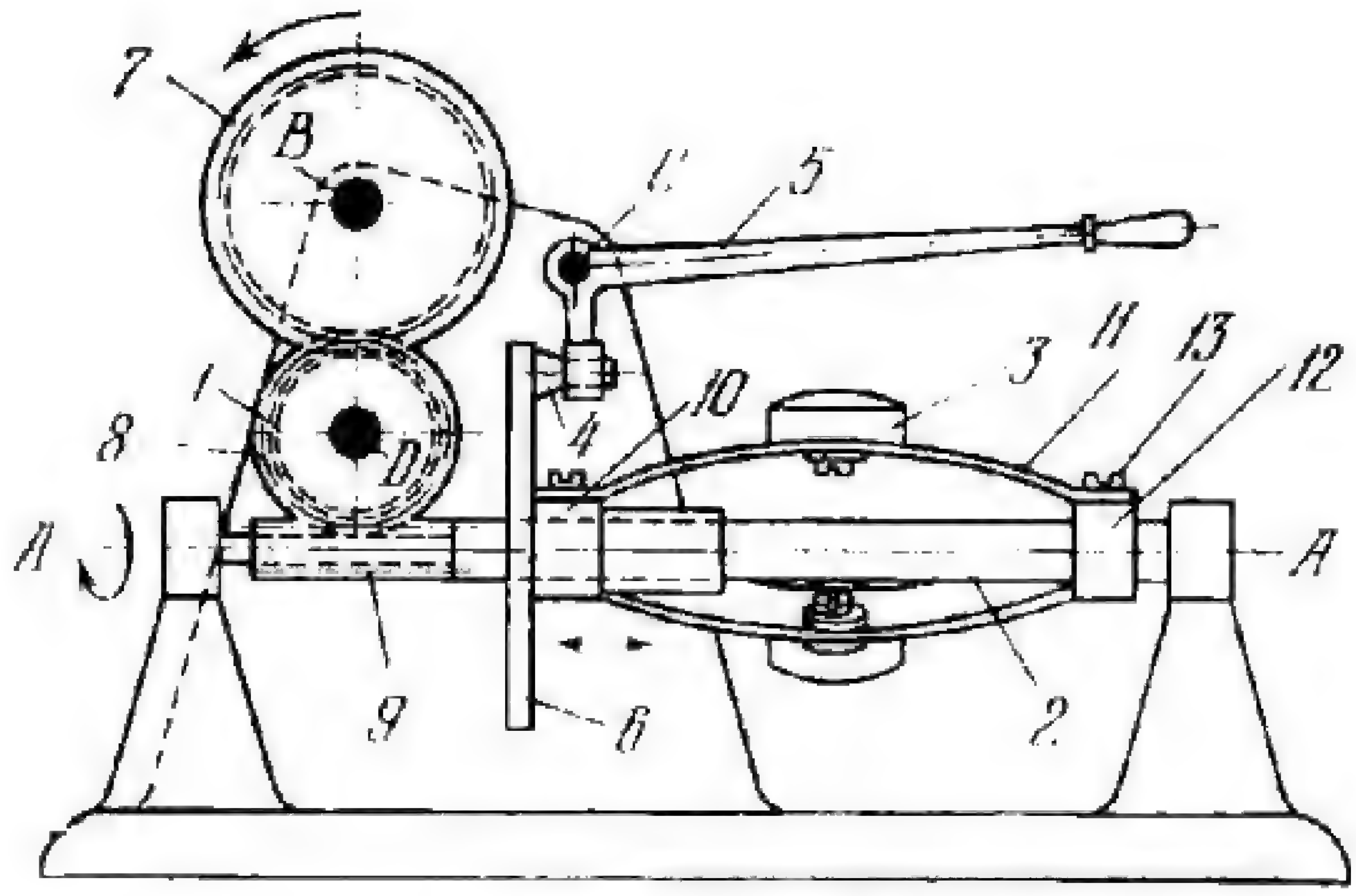
Link *1* of the clutch is keyed to shaft *7* and rotates about fixed axis *A*. Link *9* is keyed to shaft *8* and rotates about fixed axis *B*. Engaging collar *4* slides along guide *b* of link *9*. Link *10* is connected by turning pairs *D* and *C* to collar *4* and to link *6* which, in turn, is connected by turning pair *E* to link *11*. Link *11* is connected by a screw pair to screw *12*. Roller *5* rotates about axis *F* of link *6* and exerts pressure on link *14*. Link *13* can be adjusted to the required position by screw *12*. Friction shoes *2* engage rim *a* of link *1* to engage the clutch when collar *4* is shifted to the left. When collar *4* is shifted to the right, spring *3* spreads the friction shoes and the clutch is disengaged.

3454	FRICTION-LEVER SWITCHING MECHANISM	CF SE



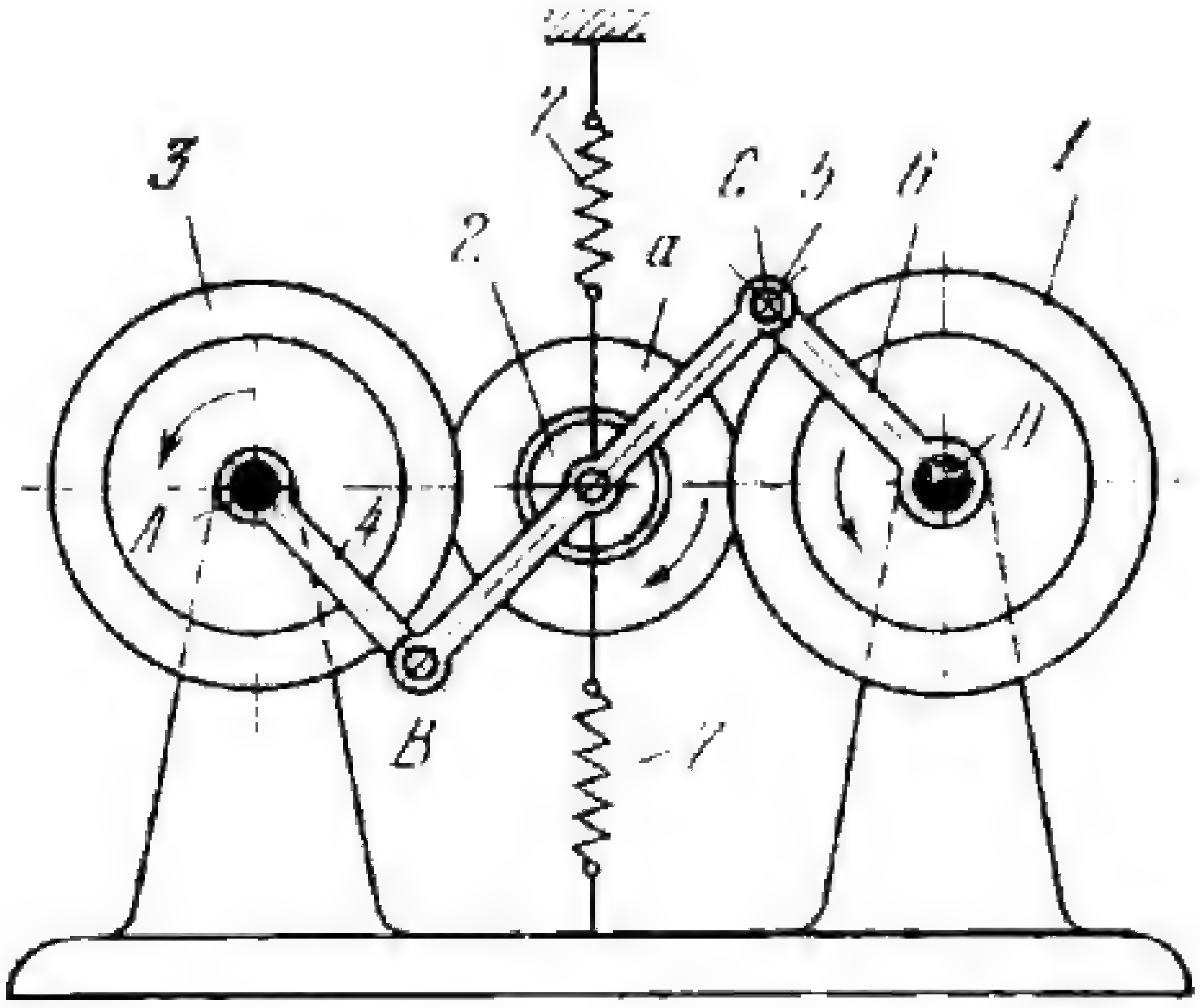
Driving friction wheel *1* rotates clockwise about fixed axis *A*. Driven friction wheel *4* rotates about fixed axis *B*. Lever *5* turns freely about axis *B* and is connected by turning pairs *C* and *D* to contacting friction wheels *3* and *2*. Lever *5* can be turned so that wheel *2* engages wheels *1* and *4* (Fig. *a*). Then wheels *1* and *4* rotate in the same direction. Figure *b* shows the neutral position of lever *5*. Here wheel *4* is stationary. In Fig. *c* wheel *3* engages wheels *1* and *2*, and wheel *2* engages wheel *4*, in which case, wheels *1* and *4* rotate in opposite directions.

3455	FRICTION MECHANISM OF AN RPM GOVERNOR	CF G



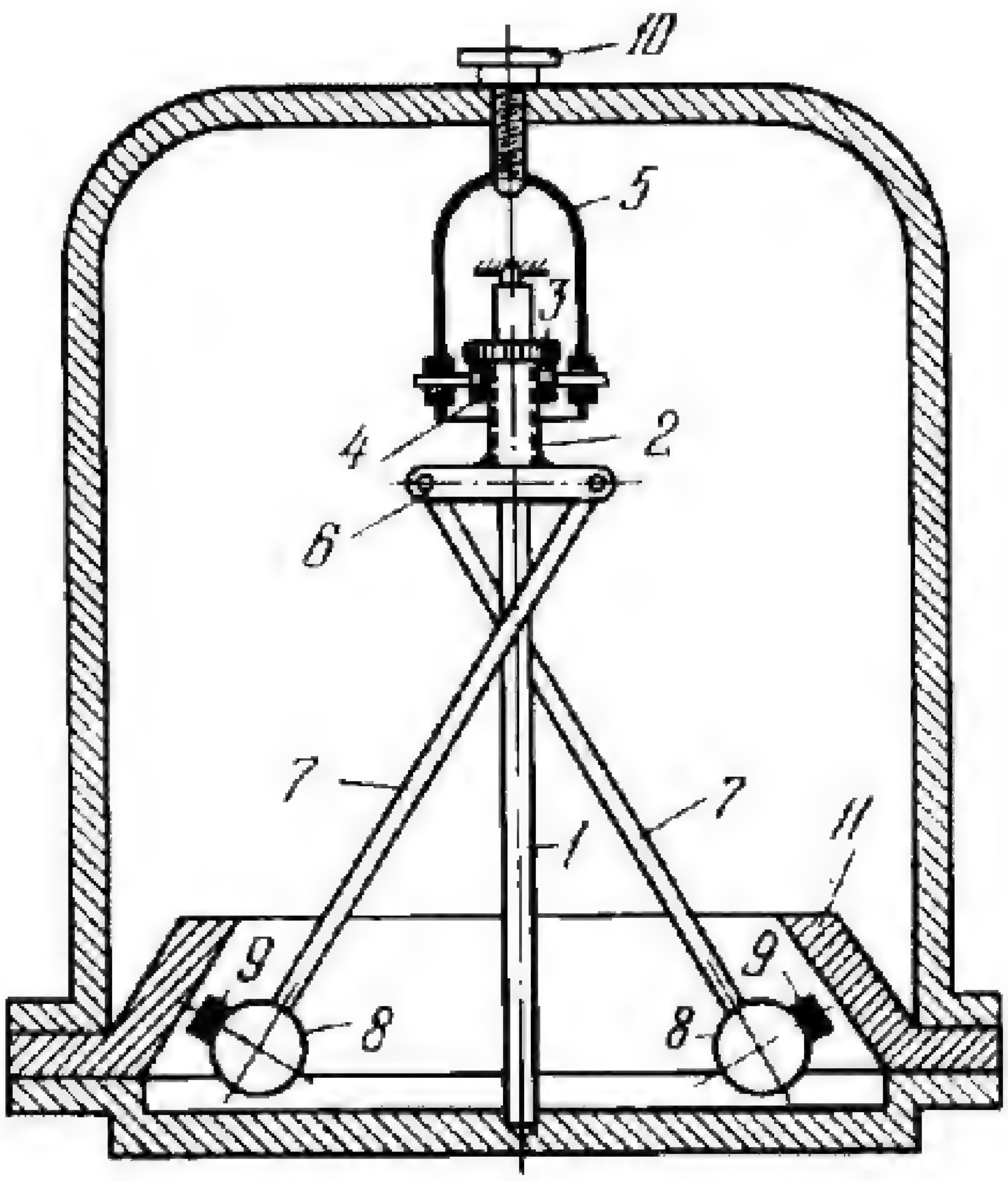
Shaft *2* rotates about fixed axis *A-A*. Shaft *2* is driven from gear *7* which rotates about fixed axis *B* and meshes with gear *1*. Gear *1* rotates about fixed axis *D* and is rigidly attached to worm wheel *8* which meshes with worm *9* having a large helix angle. Sleeve *10* with friction disk *6* can slide along shaft *2*. The left ends of flat springs *11*, carrying weights *3*, are attached to sleeve *10*. The right ends of the springs are attached to collar *12* which is rigidly clamped on shaft *2* by screw *13*. The required maximum speed of shaft *2* is set by turning lever *5* about fixed axis *C*. Lever *5* carries braking shoe *4* against which disk *6* is pulled by springs *11* when the speed of shaft *2* exceeds the maximum value.

3456	FRICTION-LEVER ELASTIC-LINK MECHANISM OF AN RPM GOVERNOR	CF G



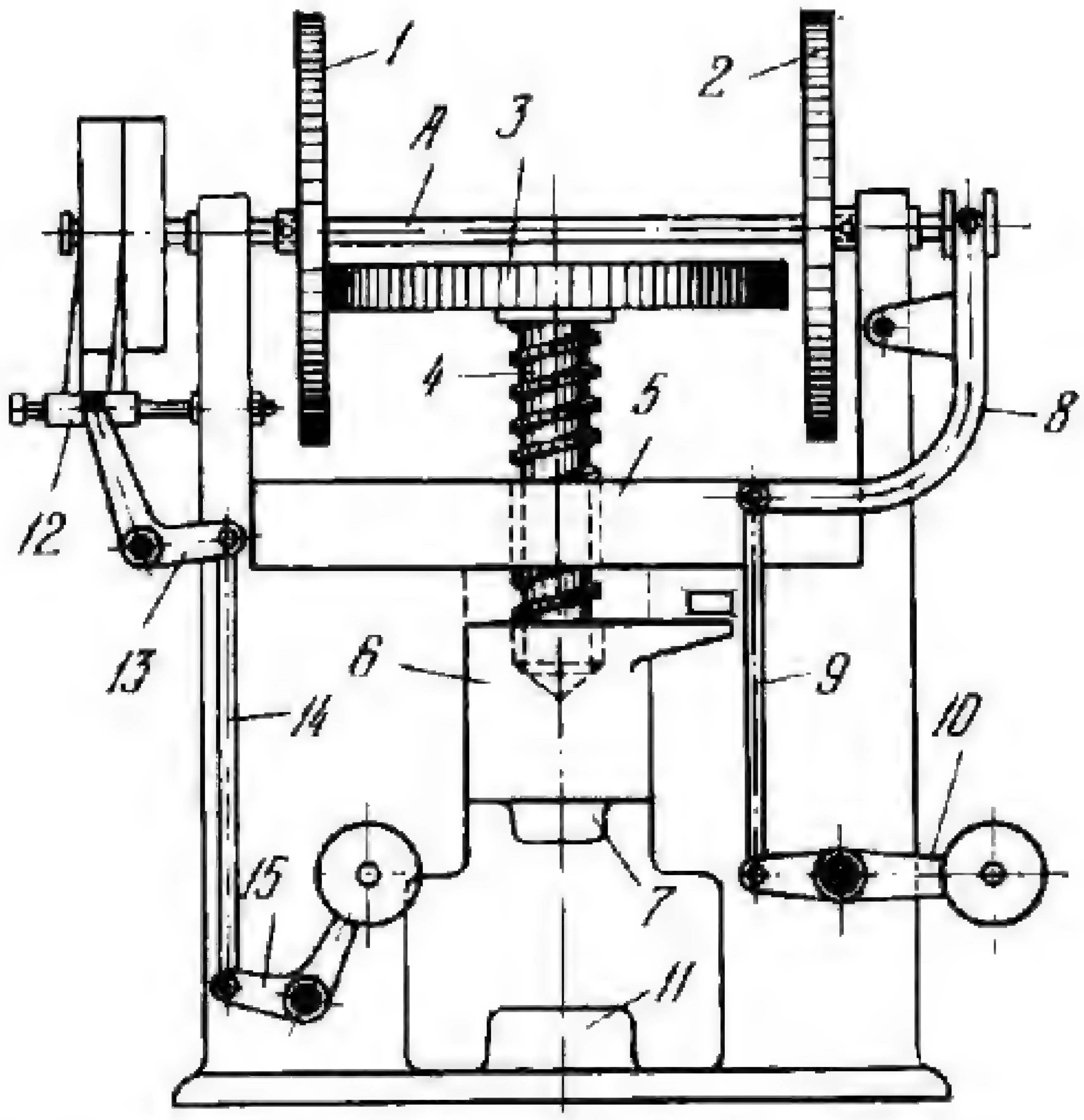
The rotation of friction wheel *1* about fixed axis *D* is transmitted through disk *2* with elastic tyre *a* to friction wheel *3* which has the same diameter as wheel *1* and rotates about fixed axis *A*. When the speed of wheel *1* changes, disk *2* tends to move vertically, but, since its axis is located at the middle point of the connecting rod of crossed-crank linkage *ABCD*, disk *2* is deflected from the vertical and is pressed against either wheel *1* or wheel *3*, depending upon whether the speed of wheel *1* increases or decreases. Linkage *ABCD* consists of links *4*, *5* and *6*, and is suspended on springs *7*. When disk *2* is thus deflected, the transmission ratio from wheel *1* to wheel *3* changes so that the speed of wheel *3* is maintained almost constant. Thus, upon variations in speed of driving wheel *1* within narrow limits, driven wheel *3* rotates at almost constant speed.

3457	FRICTION-LEVER MECHANISM OF A CENTRIFUGAL GOVERNOR	CF G



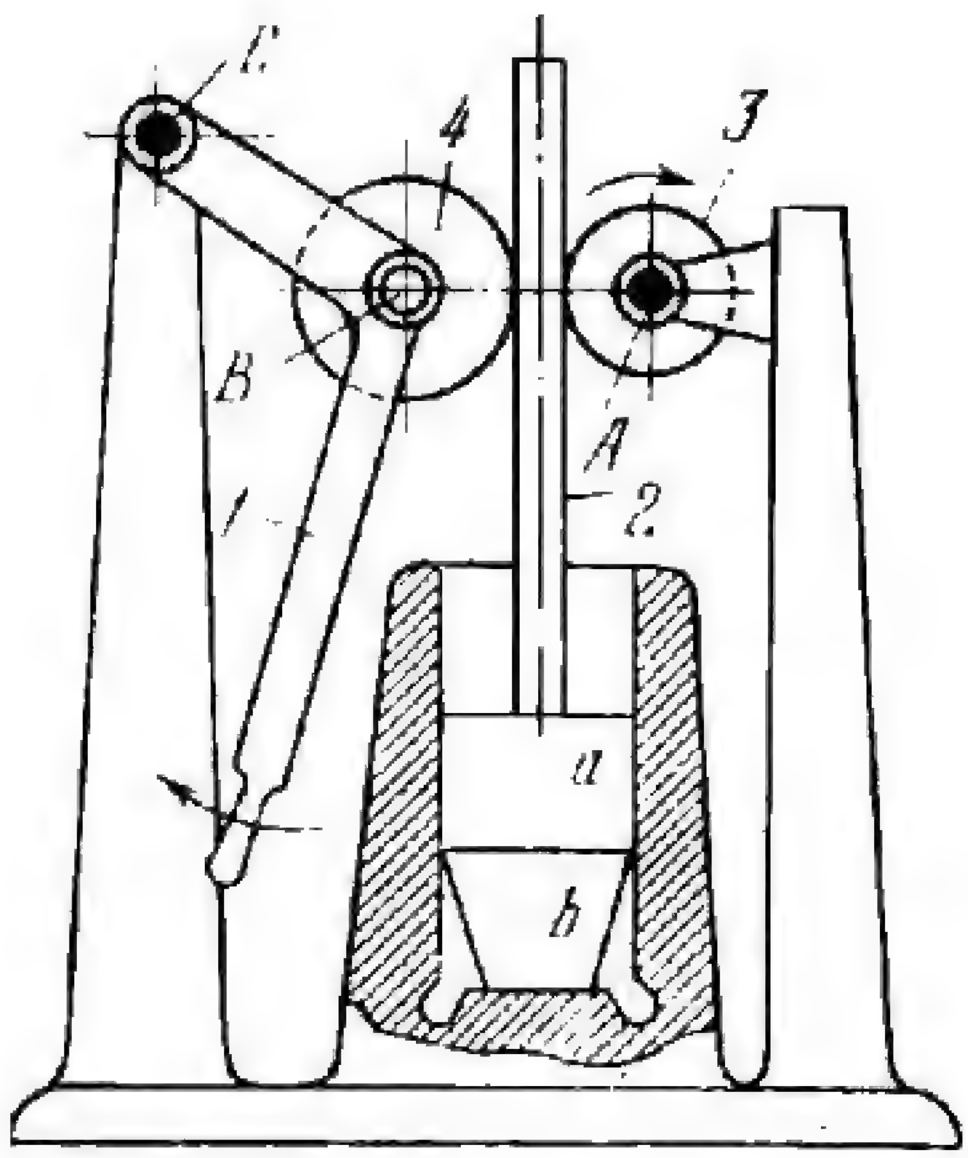
Sliding sleeve *2* is mounted at the upper end of spindle *1* and rotates with the spindle. Sleeve *2* has rigidly attached disk *3* which rests on two rollers *4*. Rollers *4* are connected by turning pairs to shackle *5*. Attached rigidly to sleeve *2* is cross-piece *6* from which two rods *7* are suspended with weights *8* at their lower ends. The weights carry braking shoes *9* which engage the inner conical surface of drum *11*. When spindle *1* rotates, weights *8* on rods *7* swing upwards. If the speed of the spindle exceeds the preset value, braking shoes *9* are pressed against drum *11*, reducing the speed. The governor is adjusted to the required maximum speed by raising or lowering the mechanism with respect to drum *11* by means of screw *10*.

3458	FRICTION SCREW PRESS MECHANISM	CF HP



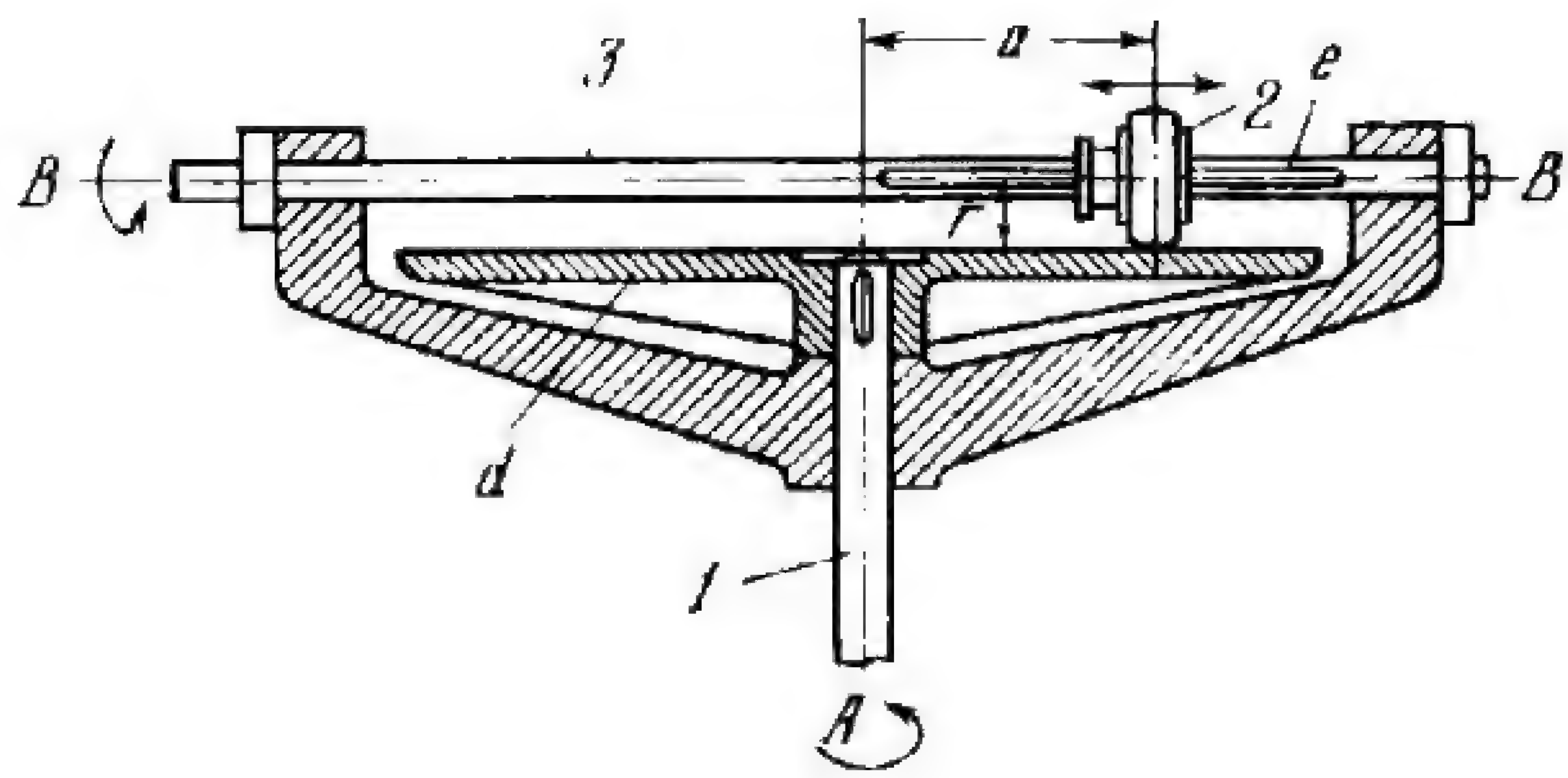
When vertical disks *1* and *2*, keyed to shaft *A*, rotate, motion is transmitted by one of them to flywheel *3* which is rigidly attached to the top of vertical screw *4*. When disk *1* is shifted into contact with flywheel *3*, screw *4*, connected by a screw pair to fixed threaded member *5*, propels ram *6* downward with increasing velocity throughout its stroke until ram die *7* strikes the work lying on anvil die *11*. The ram is returned to its top position by shifting disk *2* into contact and disk *1* out of contact with flywheel *3*. This is accomplished by lever *8* and links *9* and *10*. At this, screw *4* is reversed and ram *6* and die *7* are raised at decreasing velocity toward the end of the upstroke. Belt-shifter *12* and links *13*, *14* and *15* serve to shift the driving belt from the idle pulley to the working pulley and back again.

3459	FRICTION-BOARD DROP HAMMER MECHANISM	CF HP



Head b of the hammer slides in fixed guide a and has flat board 2 which is clamped between friction driving roll 3 and pressure roll 4. Roll 3 rotates about fixed axis A, and roll 4 about axis B of lever 1 which turns about fixed axis C. Head b is raised by the continuously rotating friction roll 3 with lever 1 in the position shown. When lever 1 is turned clockwise, head b drops by gravity, imparting a blow on the work which lies on the anvil.

3460	FRICTION DISK-AND-WHEEL INFINITELY VARIABLE DRIVE MECHANISM	CF IV

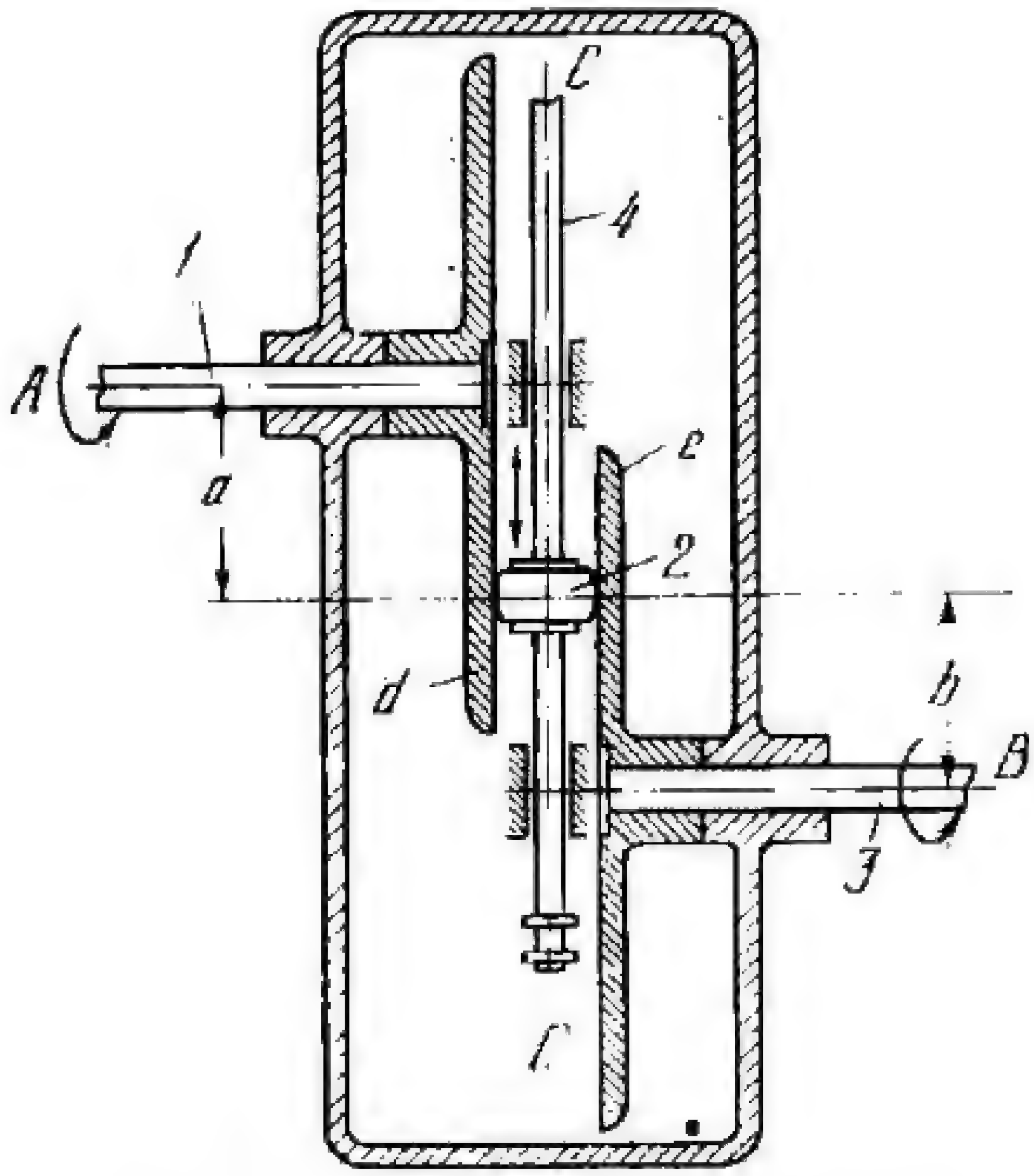


Friction disk *d* is keyed to shaft *1*, rotates about fixed axis *A* and is in contact with wheel *2* which can slide along feather key *e* on shaft *3*. Wheel *2* rotates about fixed axis *B-B* with shaft *3*. The transmission ratio from shaft *1* to shaft *3* is

$$i_{13}=\frac{\omega_1}{\omega_3}=\frac{n_1}{n_3}=\frac{r}{a}$$

where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of shafts *1* and *3*, *r* is the radius of wheel *2* and *a* is the variable distance from axis *A* to the point of contact between wheel *2* and disk *d* (at the central plane of wheel *2*). In the design shown, the transmission ratio i_{13} can be varied within the limits of the possible movement of wheel *2* along key *e*.

3461	**DOUBLE FRICTION DISK-AND-WHEEL INFINITELY VARIABLE DRIVE MECHANISM**	CF$_i$ IV

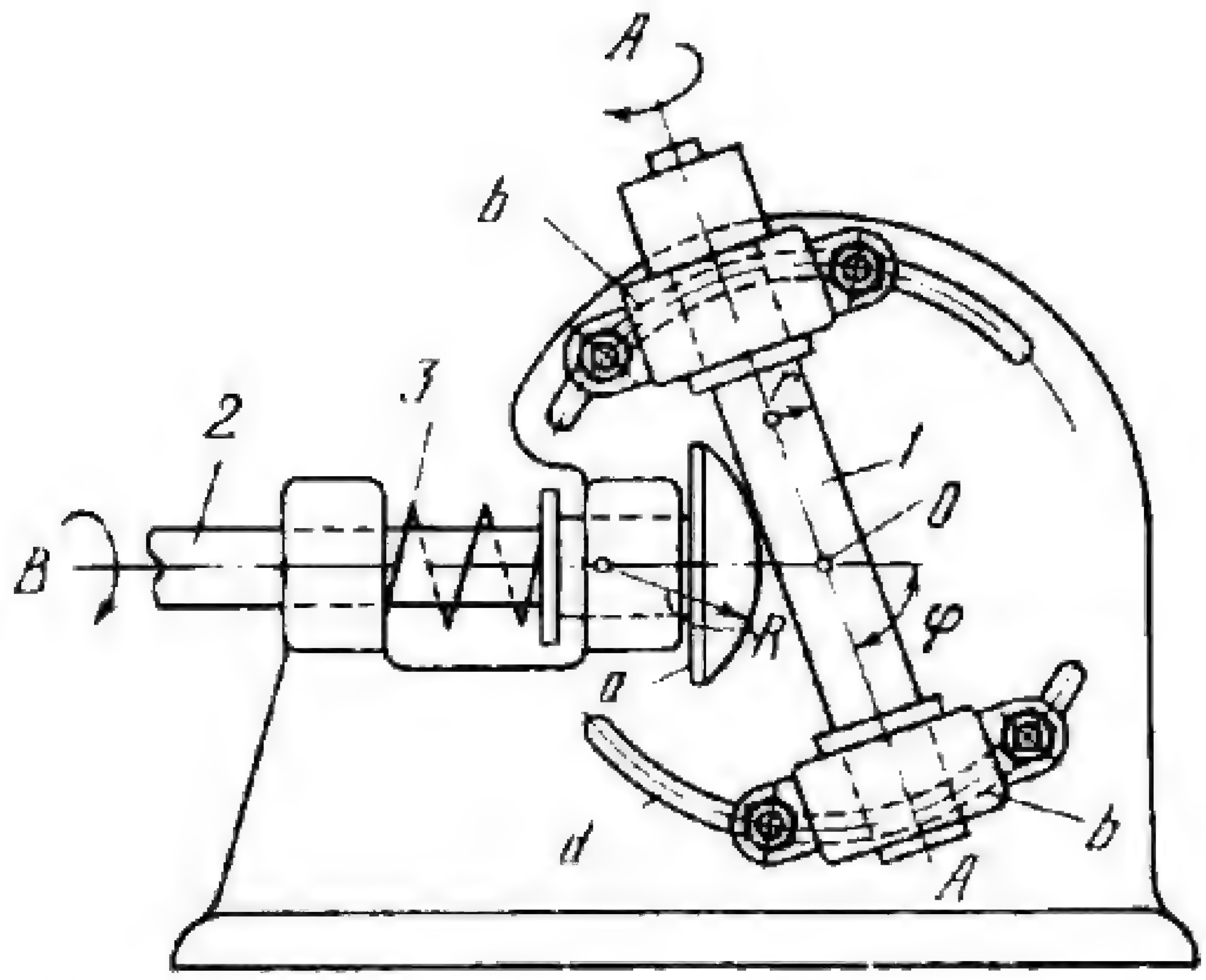


Friction disk d is keyed to shaft 1, rotates about fixed axis A and is in contact with wheel 2 which is rigidly attached to shaft 4. Wheel 2 rotates about fixed axis C-C and can slide along this axis with shaft 4. Friction disk e is keyed to shaft 3, rotates about fixed axis B and is in contact with wheel 2. The transmission ratio from shaft 1 to shaft 3 is

$$i_{13} = \frac{\omega_1}{\omega_3} = \frac{n_1}{n_3} = \frac{b}{a}$$

where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of shafts 1 and 3, and a and b are the variable distances from axes A and B to the points of contact between wheel 2 and disks d and e (at the central plane of wheel 2).

3462	FRICTION SPHERE-AND-CYLINDER INFINITELY VARIABLE DRIVE MECHANISM	CF IV

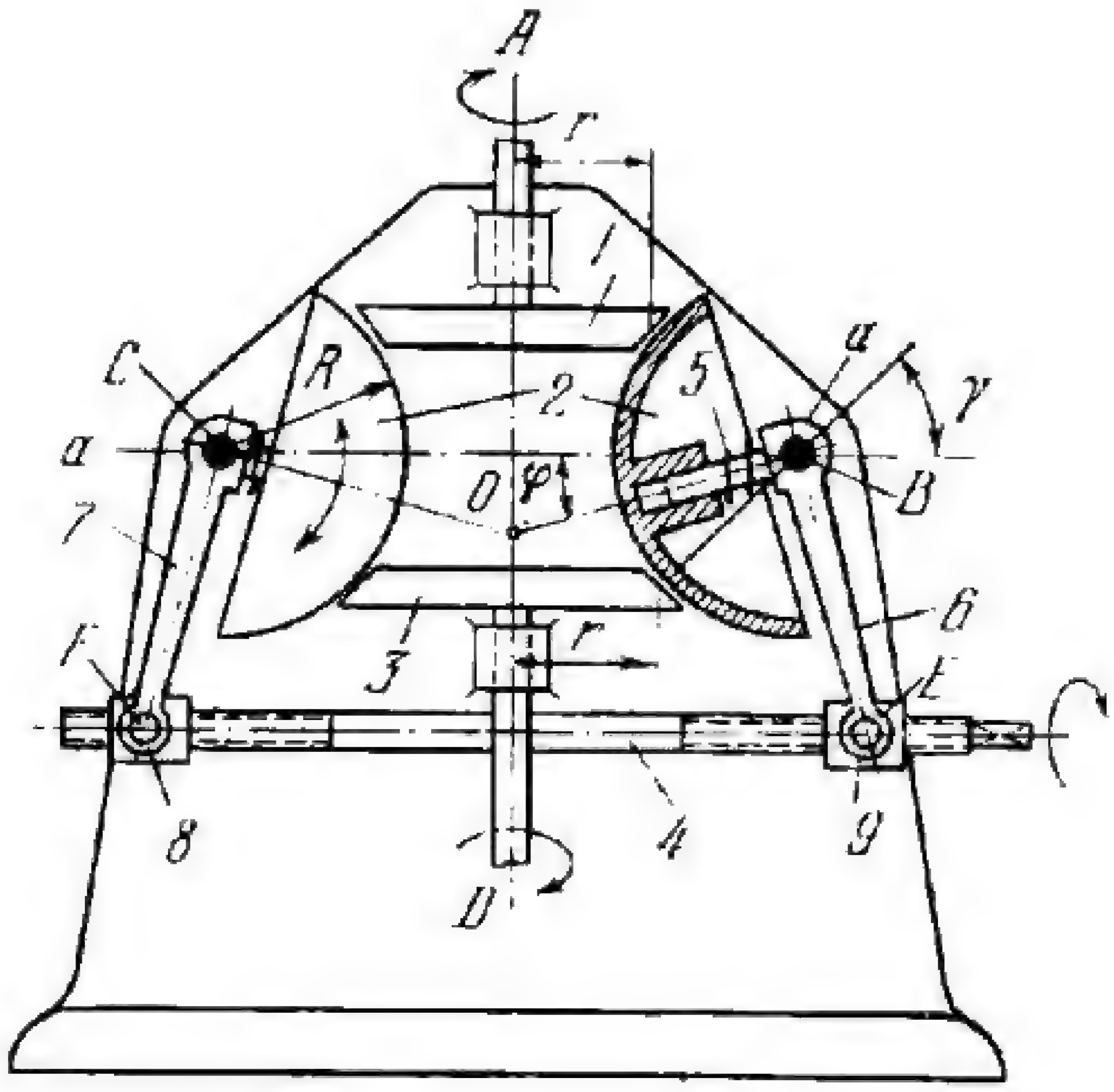


Cylinder *1* of radius *r* rotates about axis *A-A* which can be turned to various angles φ about fixed axis *O* and have its bearings *b* clamped in the required position in circular slots *d*. Cylinder *1* is in contact with semispherical roller *a* of radius *R* which rotates about fixed axis *OB* with shaft *2*. The transmission ratio from cylinder *1* to shaft *2* is

$$i_{12}=\frac{\omega_1}{\omega_2}=\frac{n_1}{n_2}=\frac{R}{r}\cos\varphi$$

where ω_1, ω_2, n_1 and n_2 are the angular velocities and speeds (in rpm) of cylinder *1* and shaft *2*, and φ is the angle between axes *A-A* and *OB*. The pressure required between the friction surfaces to transmit a torque is developed by spring *3*.

3463	**DOUBLE FRICTION SPHERE-AND-DISK INFINITELY VARIABLE DRIVE MECHANISM**	CF IV

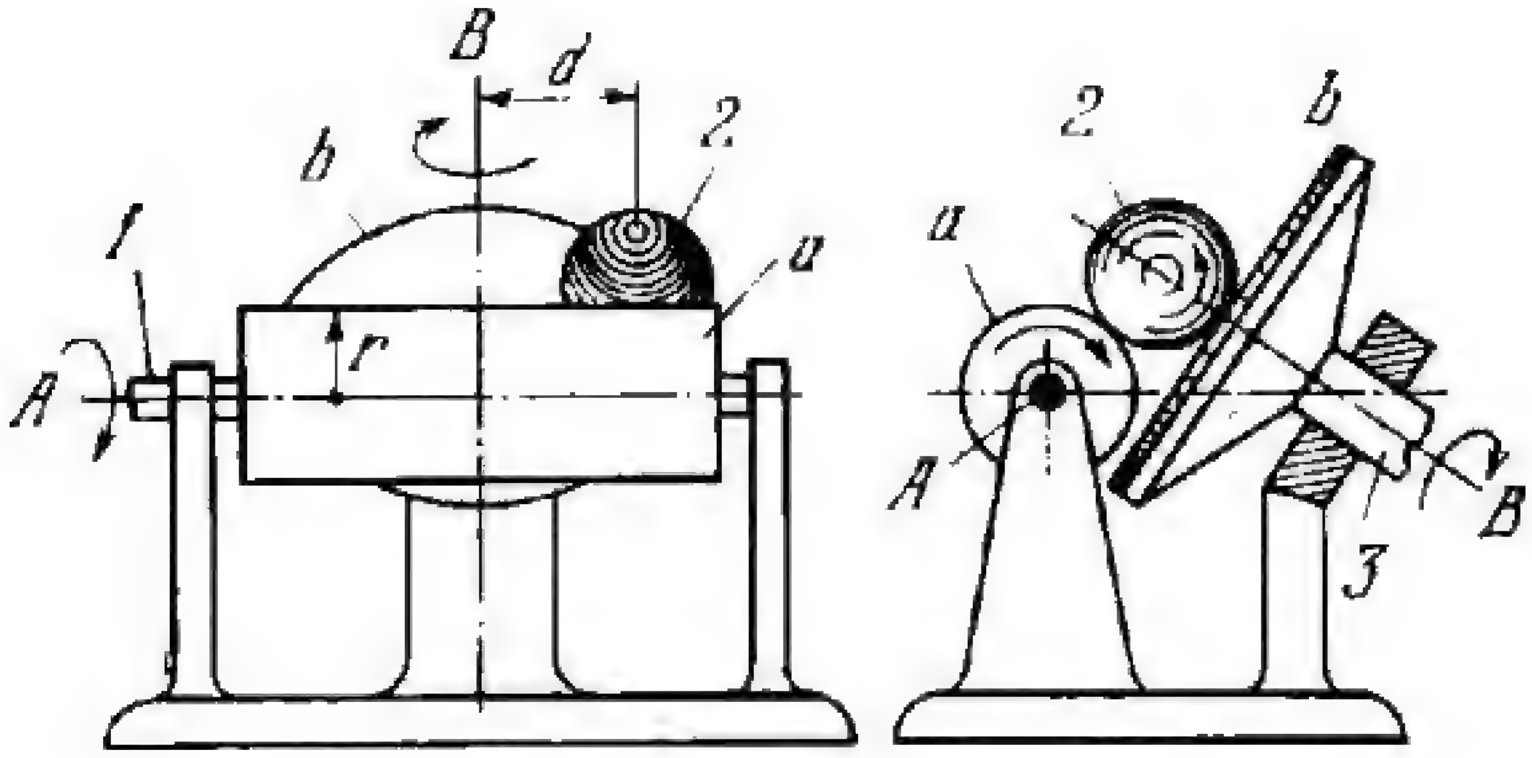


Tapered friction disk *1* rotates about fixed axis *A* and is in contact with two identical hemispheres *2* which rotate about axes *OC* and *OB*, and can be swivelled about fixed axes *C* and *B* of pins *a* of levers *7* and *6*. Tapered friction disk *3* rotates about fixed axis *D* and is also in contact with hemispheres *2*. Levers *6* and *7* are connected by turning pairs *E* and *F* to nuts *9* and *8*, connected, in turn, by screw pairs to screw *4*. Screw *4* has right-hand thread at one end and left-hand thread at the other. The lengths of the links comply with the conditions: $\overline{CF} = \overline{BE}$, the radii *r* of the circles of contact of disks *1* and *3* are equal, as are the radii *R* of hemispheres *2*. Owing to the symmetrical arrangement of the disks and levers *6* and *7*, hemispheres *2* swivel through equal angles φ when screw *4* is turned, and the axes of rotation of the hemispheres intersect at point *O*. The transmission ratio from disk *1* to disk *3* is

$$i_{13} = \frac{\omega_1}{\omega_3} = \frac{n_1}{n_3} = \frac{\sin(\gamma+\varphi)}{\sin(\gamma-\varphi)}$$

where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of disks *1* and *3*, and γ is a constant angle equal to one half the angle between the straight lines passing through point *B* or *C* and the points of contact between disks *1* and *3* and a hemisphere *2*. The pressure required between the friction surfaces to transmit a torque is developed by springs *5*.

3464	FRICTION DISK-BALL-AND-ROLLER INFINITELY VARIABLE DRIVE MECHANISM	CF IV

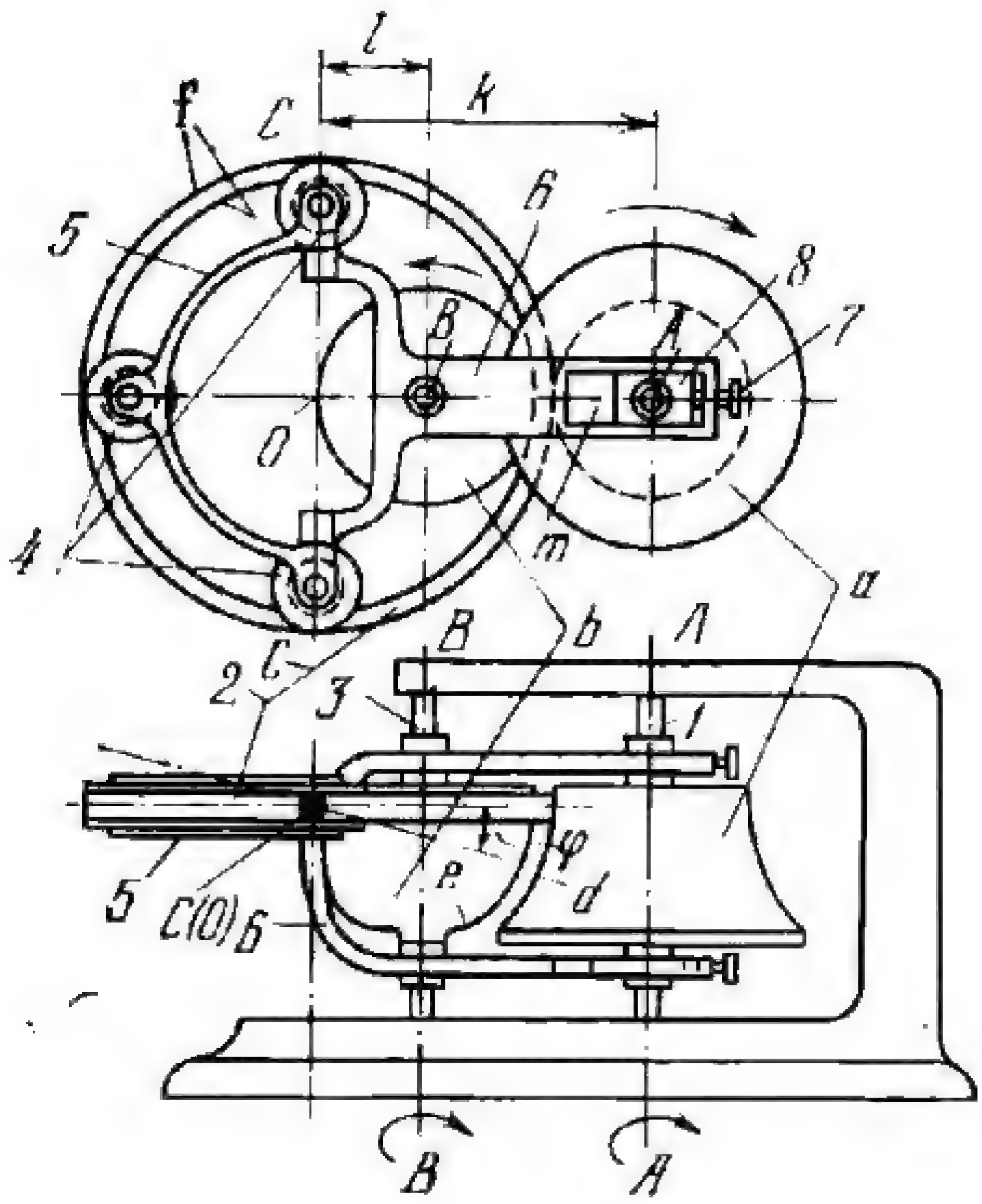


Shaft *1* with friction roller *a* rotates about fixed axis *A* and is in contact with ball *2* which, in turn, is in contact with friction disk *b*. Shaft *3* with disk *b* rotates about fixed axis *B*. The transmission ratio from shaft *1* to shaft *3* is

$$i_{13}=\frac{\omega_1}{\omega_3}=\frac{n_1}{n_3}=\frac{d}{r}$$

where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of shafts *1* and *3*, *r* is the radius of roller *a* and *d* is the variable distance from the centre of ball *2* to axis *B*. The ball can be moved along roller *a* and disk *b* by a special carrier (not shown).

3465	FRICTION TOROIDAL-AND-SPHERICAL-RING INFINITELY VARIABLE DRIVE MECHANISM	CF IV

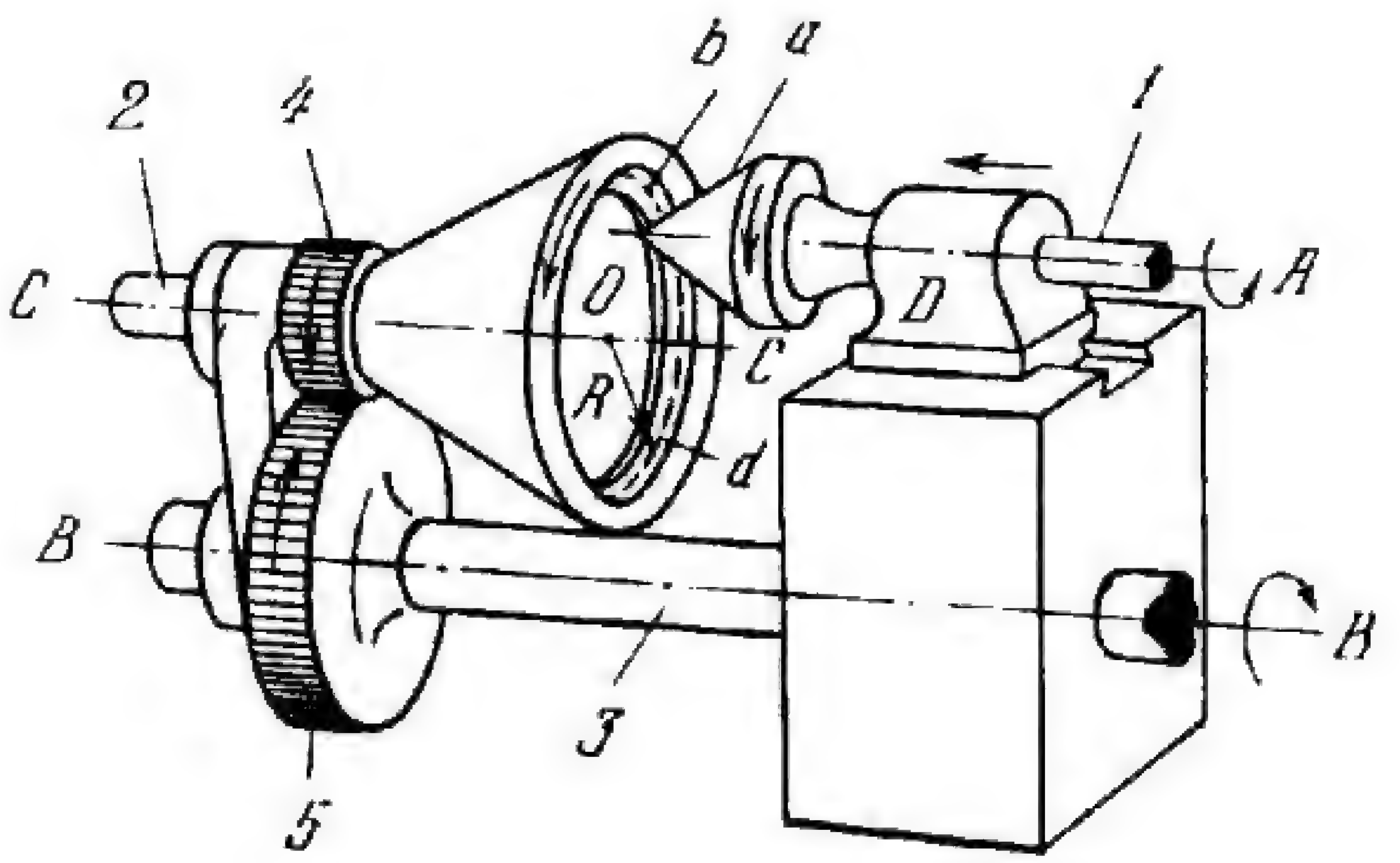


Shaft *1* with concave toroidal friction wheel *a* rotates about fixed axis *A-A*. Shaft *3* with convex toroidal friction wheel *b* rotates about fixed axis *B-B*. Between wheels *a* and *b*, and in contact with them, is spherical ring *2*. The generatrices *d* and *e* of wheels *a* and *b*, and *f* of the inner and outer surfaces of ring *2* are circular arcs described from the common centre *O* which lies on fixed axis *C-C*. Ring *2* is supported by rollers *4* of link *5* and can swivel with this link about axis *C-C* of frame *6* to set ring *2* in various positions with respect to wheels *a* and *b*. The pressure required between the friction surfaces is developed by screws *7* which push against slide-blocks *8*. Blocks *8* can slide along slots *m* in frame *6*, and carry the bearings of shaft *1*. The transmission ratio from shaft *1* to shaft *3* is

$$i_{13}=\frac{\omega_1}{\omega_3}=\frac{n_1}{n_3}=\frac{l-R_2''\cos\varphi}{k-R_2'\cos\varphi}$$

where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of shafts *1* and *3*, *l* and *k* are the distances from axis *C-C* to axes *B-B* and *A-A*, R_2' and R_2'' are the outer and inner radii of the middle section of ring *2*, and φ is the angle of swivel of ring *2* about axis *C-C*.

3466	FRICTION CONE PARALLEL-AXES INFINITELY VARIABLE DRIVE MECHANISM	CF IV

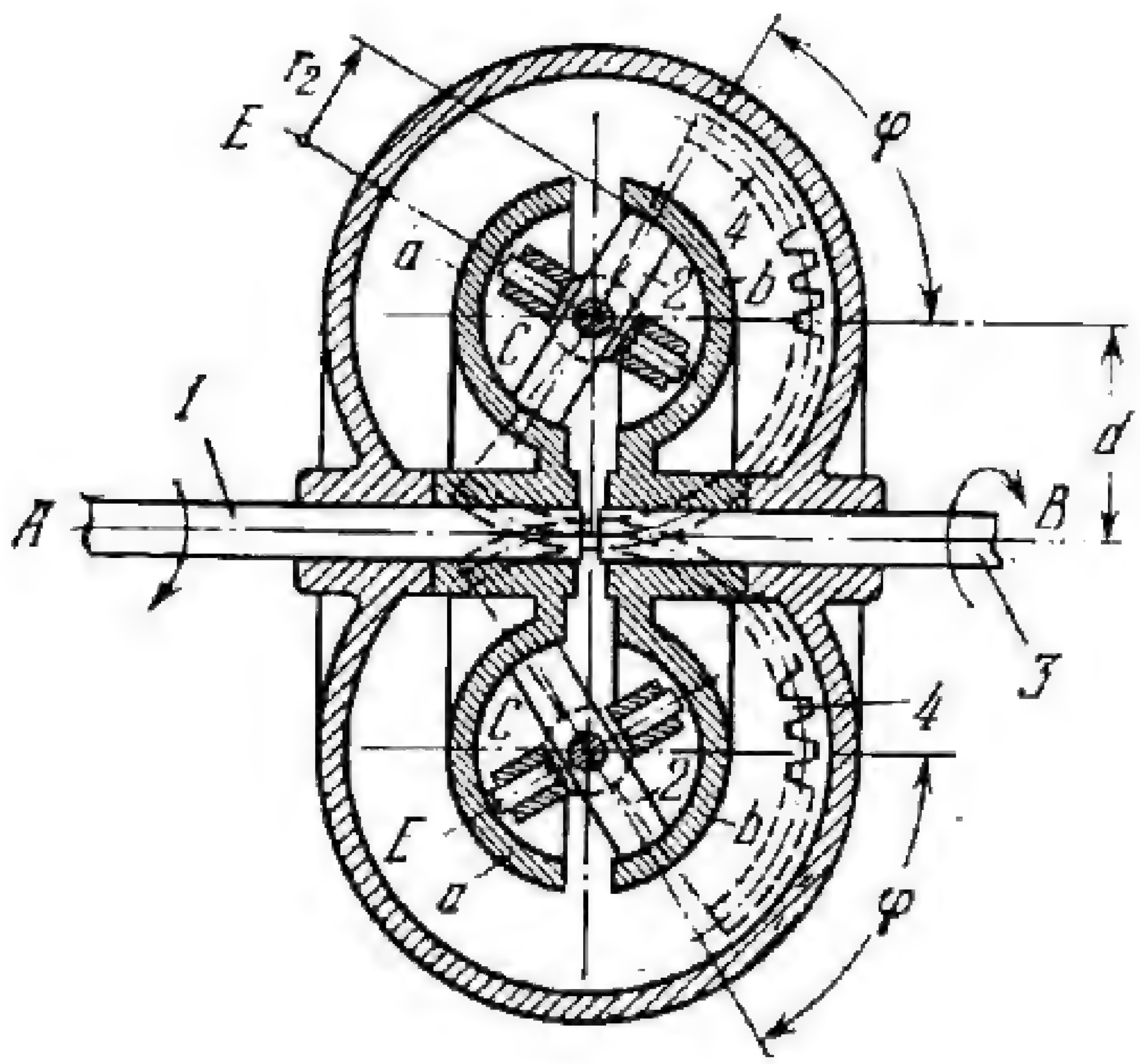


Shaft *1* with conical friction wheel *a* rotates about fixed axis *A*. Shaft *2* with conical friction ring *b* rotates about axis *C-C*. Cylindrical friction wheel *4*, keyed to shaft *2*, is in contact with cylindrical friction wheel *5* which is keyed to shaft *3* and rotates about fixed axis *B-B*. Shaft *1* can slide forward in bearing *D* and shaft *2* can be swivelled about axis *B-B* to bring wheel *a* into contact with the inner surface of ring *b*. The transmission ratio from shaft *1* to shaft *3* is

$$i_{13}=\frac{\omega_1}{\omega_3}=\frac{n_1}{n_3}=\frac{R}{r}\frac{r_5}{r_4}$$

where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of shafts *1* and *3*, R is the radius of the circle d on the inner surface of ring b which lies in the median plane perpendicular to parallel axes A and C-C, r is the radius of the circular cross section of conical wheel a in the same plane, and r_4 and r_5 are the radii of wheels *4* and *5*.

3467	FRICTION TOROIDAL COAXIAL INFINITELY VARIABLE DRIVE MECHANISM	CF IV

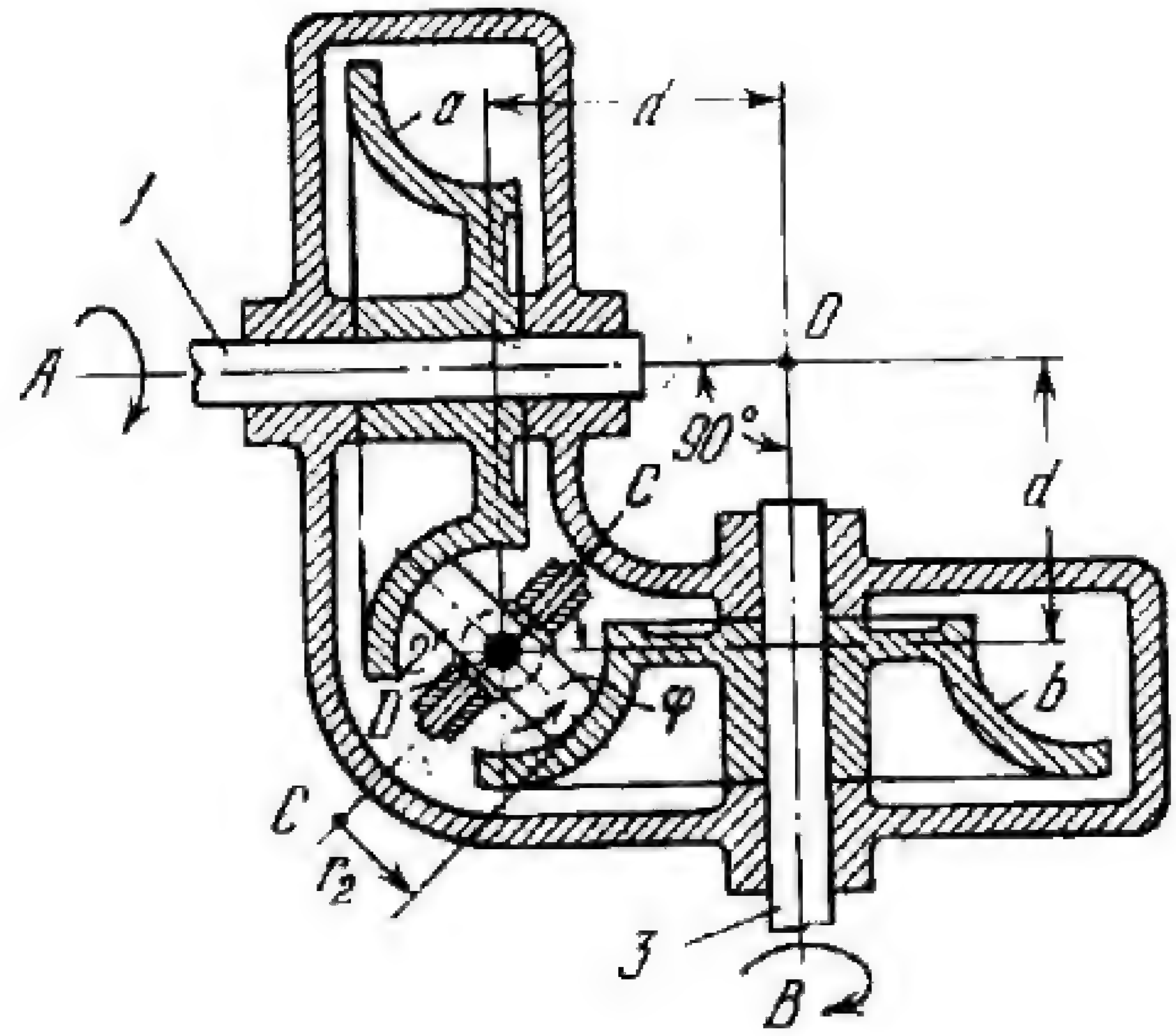


Toroidal friction wheel a is keyed to shaft 1 and rotates about fixed axis A. Toroidal friction wheel b is keyed to shaft 3 and rotates about fixed axis B. Shafts 1 and 3 are coaxial. Rollers 2 are in contact with wheels a and b and rotate about axes E. The planes of rollers 2 make equal angles φ with axes A and B. Rollers 2 can be set to various angles by swivelling them about axes C, which are perpendicular to the plane of the drawing, with the aid of identical gear segments 4. The transmission ratio from shaft 1 to shaft 3 is

$$i_{13}=\frac{\omega_1}{\omega_3}=\frac{n_1}{n_3}=\frac{d-r_2\sin\varphi}{d+r_2\sin\varphi}$$

where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of shafts 1 and 3, d is the distance between axis C and axes A and B, and r_2 is the radius of roller 2.

3468	FRICTION TOROIDAL RIGHT-ANGLE INFINITELY VARIABLE DRIVE MECHANISM	CF IV

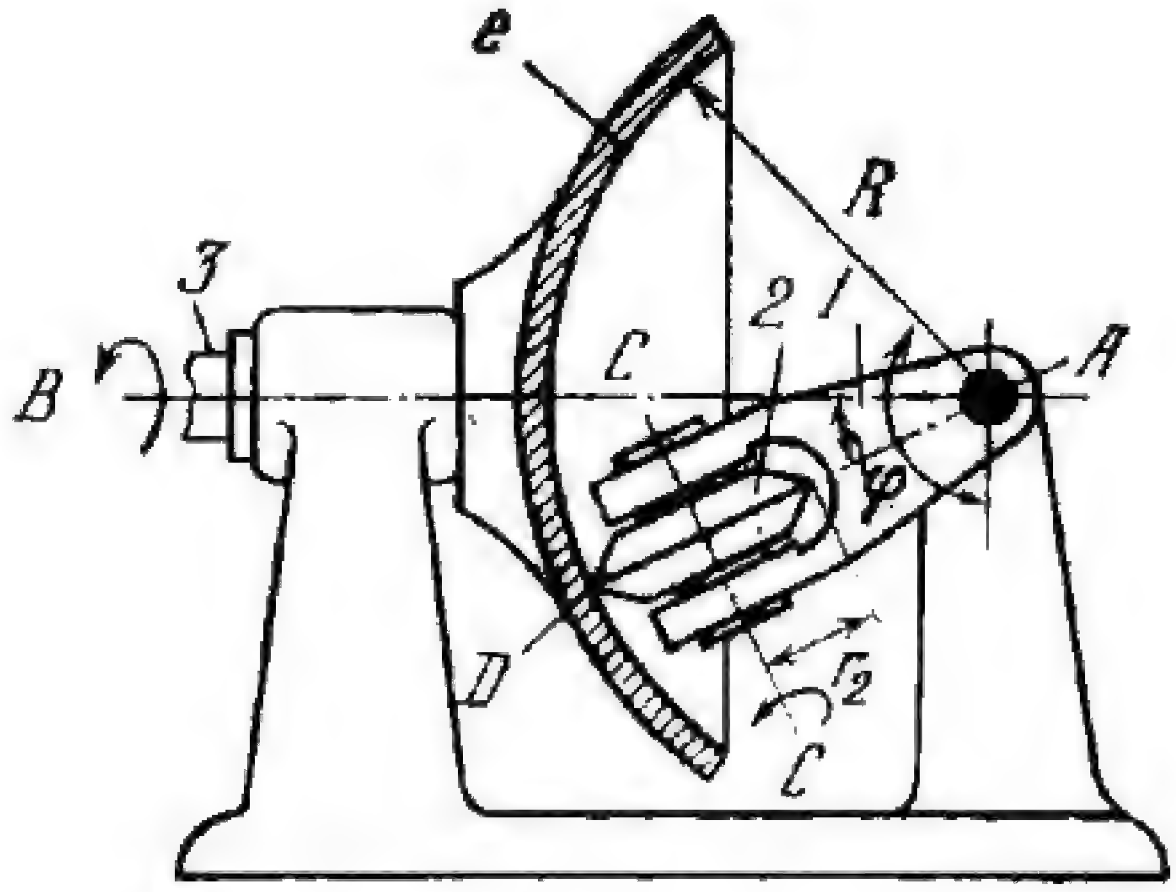


Toroidal friction wheel *a* is keyed to shaft *1* and rotates about fixed axis *A*. Toroidal friction wheel *b*, identical to wheel *a*, is keyed to shaft *3* and rotates about fixed axis *B*. Axes *A* and *B* of shafts *1* and *3* are perpendicular to each other and intersect at point *O*. Roller *2* is in contact with wheels *a* and *b* and rotates about axis *C*. Roller *2* can be set to various angles φ by swivelling it about axis *D* which is perpendicular to the plane of the drawing. The transmission ratio from shaft *1* to shaft *3* is

$$i_{13} = \frac{\omega_1}{\omega_3} = \frac{n_1}{n_3} = \frac{d - r_2 \cos\varphi}{d - r_2 \sin\varphi}$$

where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of shafts *1* and *3*, *d* is the distance from axis *D* to axes *A* and *B*, and r_2 is the radius of roller *2*.

3469	FRICTION SPHERICAL WHEEL INFINITELY VARIABLE DRIVE MECHANISM	CF IV

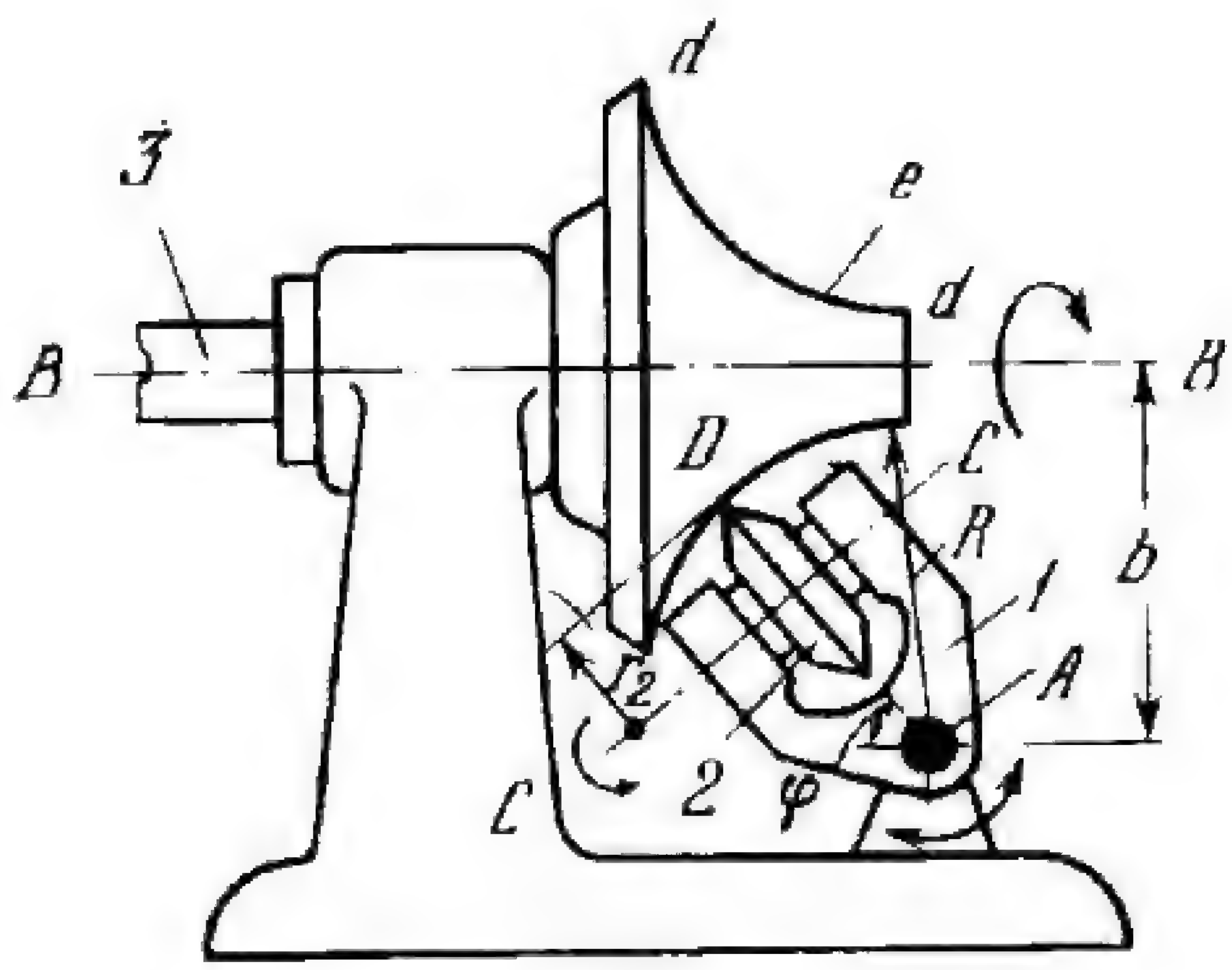


Link *1* turns about fixed axis *A* and carries roller *2* which rotates about axis *C-C*. Roller *2* is in contact at point *D* with internal hemisphere *e* which has its centre at point *A*, is keyed to shaft *3* and rotates about fixed axis *B*. The transmission ratio from roller *2* to shaft *3* is

$$i_{23} = \frac{\omega_2}{\omega_3} = \frac{n_2}{n_3} = \frac{R}{r_2} \sin \varphi$$

where ω_2, ω_3, n_2 and n_3 are the angular velocities and speeds (in rpm) of roller *2* and shaft *3*, R is the radius of hemisphere *e*, r_2 is the radius of roller *2* and φ is the variable angle between the plane of roller *2* and a plane passing through axes *B* and *A*.

3470	FRICTION TOROIDAL WHEEL INFINITELY VARIABLE DRIVE MECHANISM	CF IV

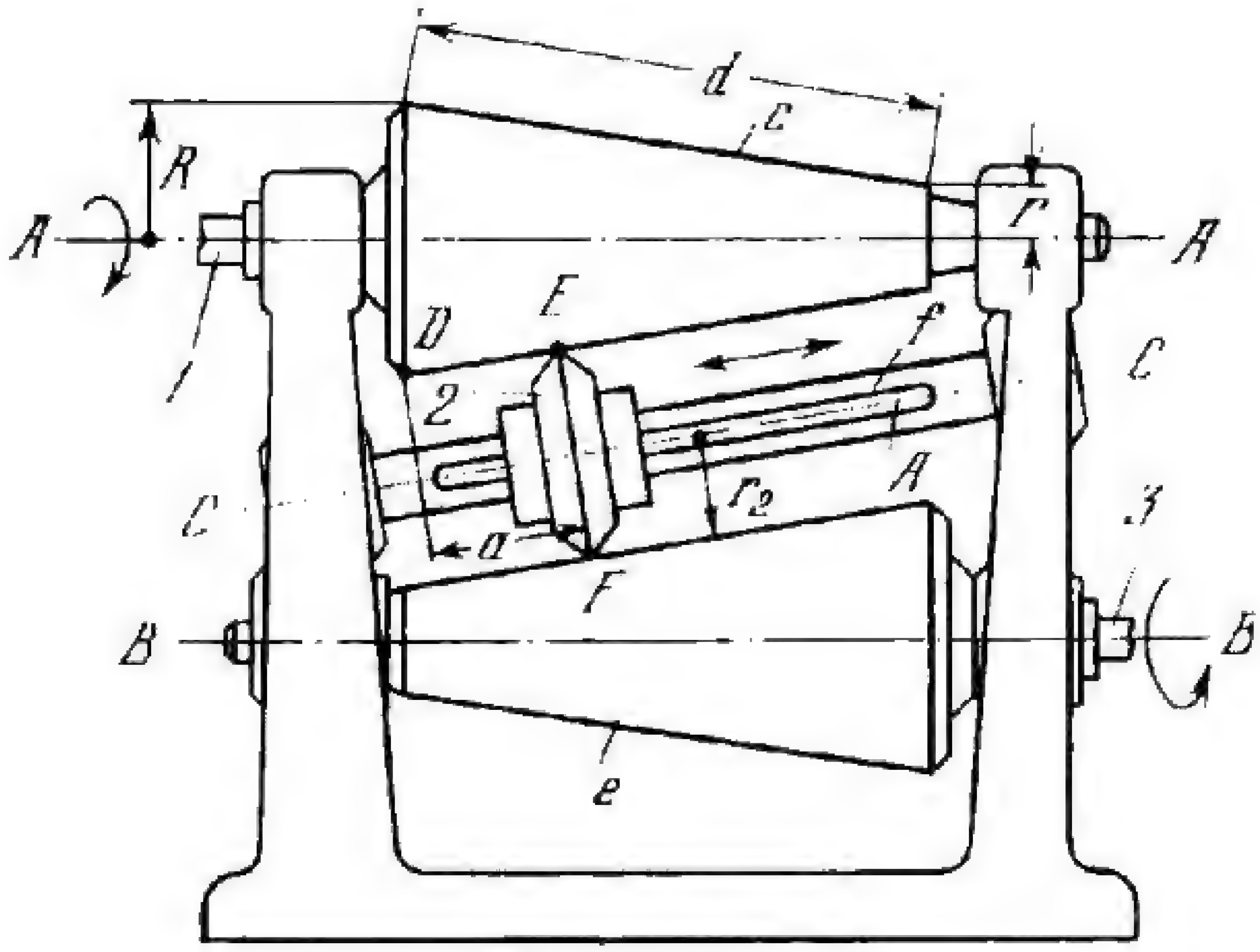


Link *1* turns about fixed axis *A* and carries roller *2* which rotates about axis *C-C*. Roller *2* is in contact at point *D* with toroidal wheel *e* whose generatrix is a circular arc described from point *A*. Wheel *e* is keyed to shaft *3* and rotates about fixed axis *B-B*. The transmission ratio from roller *2* to shaft *3* is

$$i_{23}=\frac{\omega_2}{\omega_3}=\frac{n_2}{n_3}=\frac{b-R\sin\varphi}{r_2}$$

where ω_2, ω_3, n_2 and n_3 are the angular velocities and speeds (in rpm) of roller *2* and shaft *3*, b is the distance from axis *A* to axis *B-B*, R is the radius of arc *d-d* on wheel *e*, r_2 is the radius of roller *2* and φ is the variable angle between the plane of roller *2* and a plane passing through axis *A* and parallel to axis *B-B*.

3471	DOUBLE-CONE FRICTION ROLLER INFINITELY VARIABLE DRIVE MECHANISM	CF IV

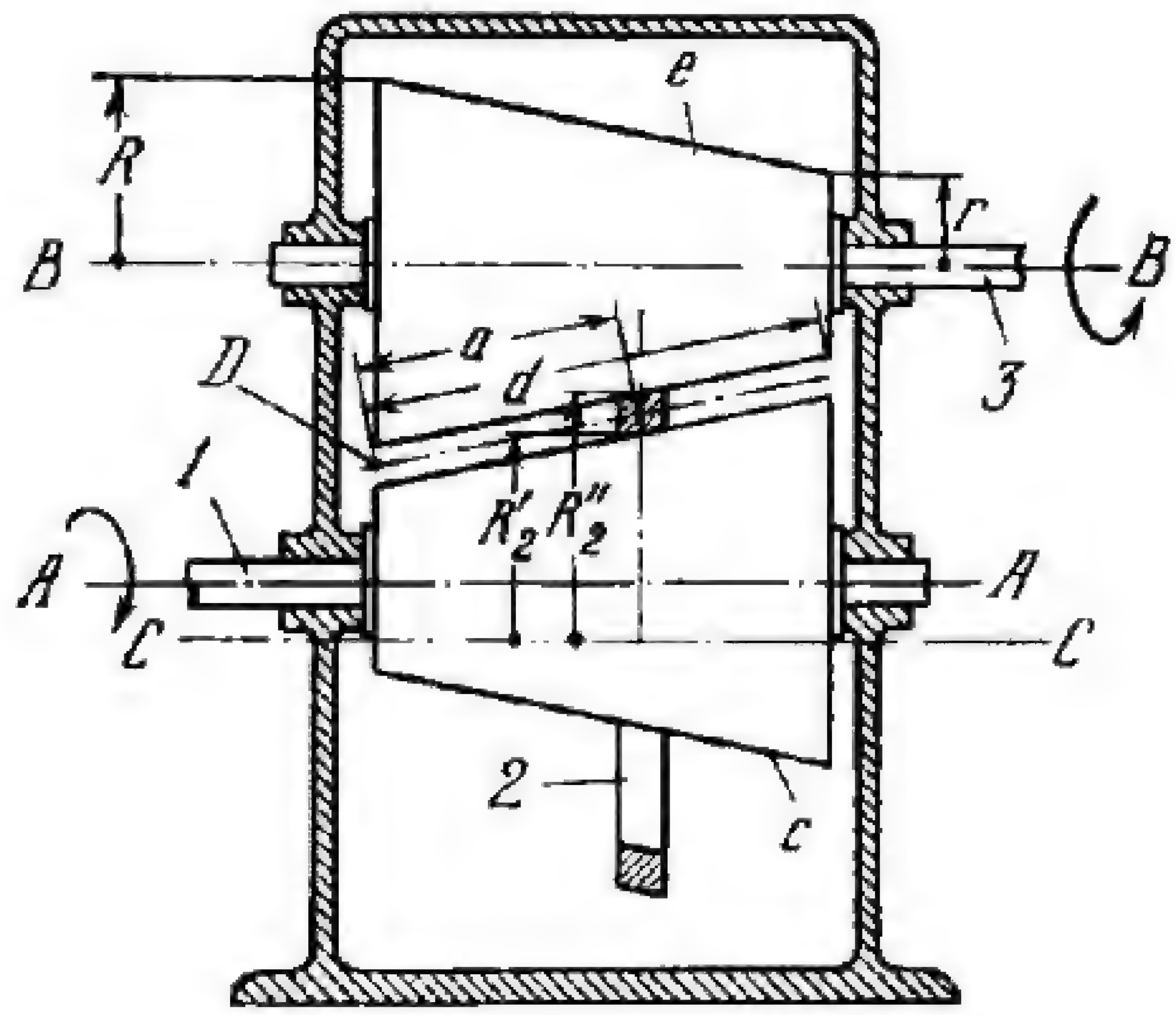


Friction cone c is keyed to shaft 1 and rotates about fixed axis A-A. Friction cone e, identical to cone c, is keyed to shaft 3 and rotates about fixed axis B-B. Roller 2 rotates about fixed axis C-C and can slide along this axis on feather key f. The roller is in contact with cones c and e at points E and F. The transmission ratio from shaft 1 to shaft 3 is

$$i_{13}=\frac{\omega_1}{\omega_3}=\frac{n_1}{n_3}=\frac{rd+(R-r)(a+m)}{Rd-(R-r)a}$$

where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of shafts 1 and 3, R and r are the radii of the large and small ends of the cones, d is the length of an element of the cones, a is the variable distance from point D at the large end of cone c to point E of contact of roller 2 and cone c, and constant $m=2\,\dfrac{R-r}{d}\,r_2$, with r_2 being the radius of roller 2.

3472	DOUBLE-CONE FRICTION RING INFINITELY VARIABLE DRIVE MECHANISM	CF IV

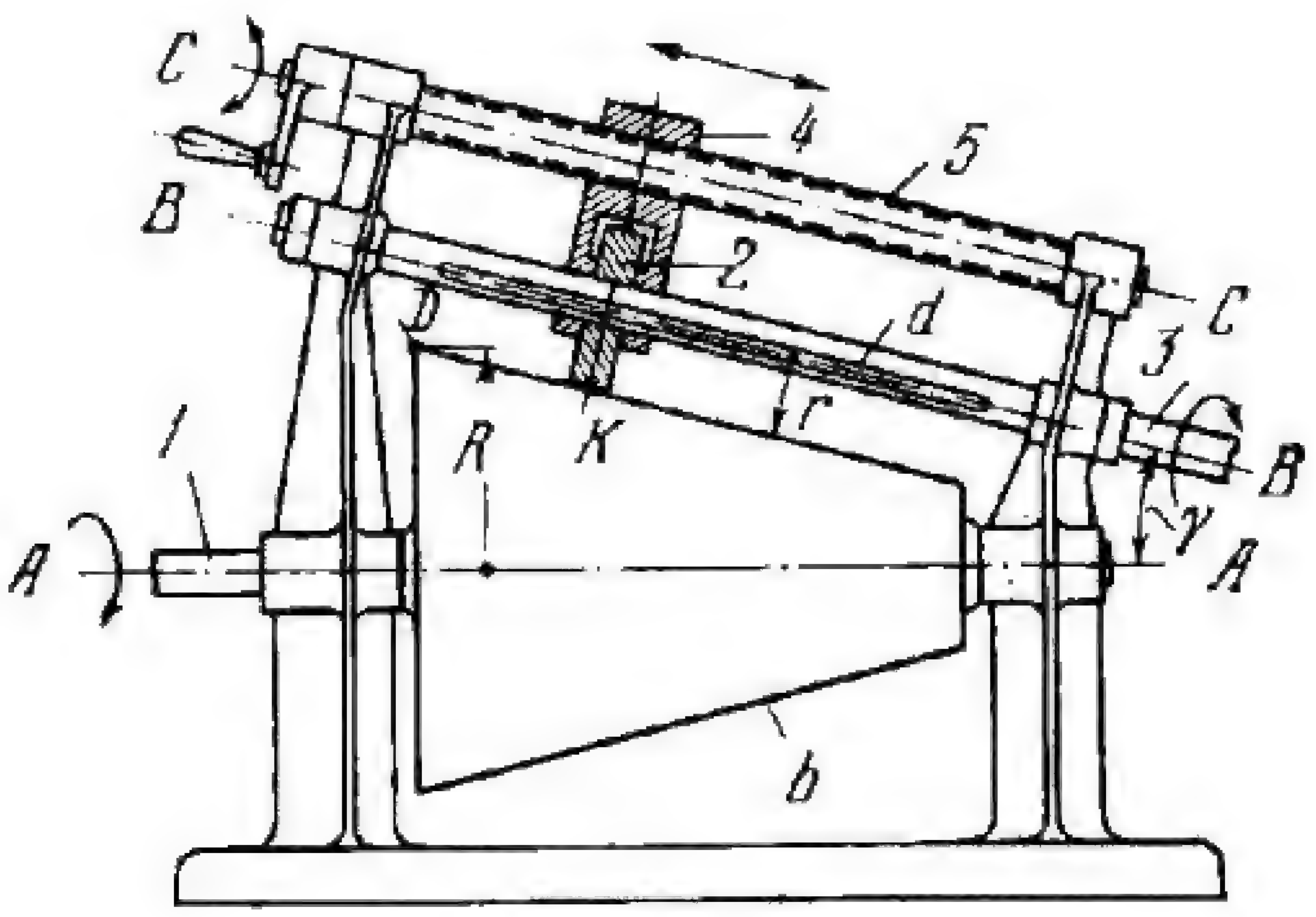


Friction cone c is keyed to shaft 1 and rotates about fixed axis A-A. Friction cone e, identical to cone c, is keyed to shaft 3 and rotates about fixed axis B-B. Tapered ring 2, between and in contact with cones c and e, rotates about axis C-C. The ring can be shifted along the elements of the cones. The transmission ratio from shaft 1 to shaft 3 is

$$i_{13}=\frac{\omega_1}{\omega_3}=\frac{n_1}{n_3}=\frac{rd+(R-r)a}{Rd-(R-r)a}\,\frac{R_2''}{R_2'}$$

where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of shafts 1 and 3, R and r are the radii of the large and small ends of the cones, d is the length of an element of the cones, a is the variable distance from the central cross section of ring 2 to point D at the end plane of the cones and on the middle line between their elements, and R_2' and R_2'' are the inner and outer radii of the central cross section of ring 2.

3473	FRICTION CONE INFINITELY VARIABLE DRIVE MECHANISM WITH A SCREW-ADJUSTED ROLLER	CF IV

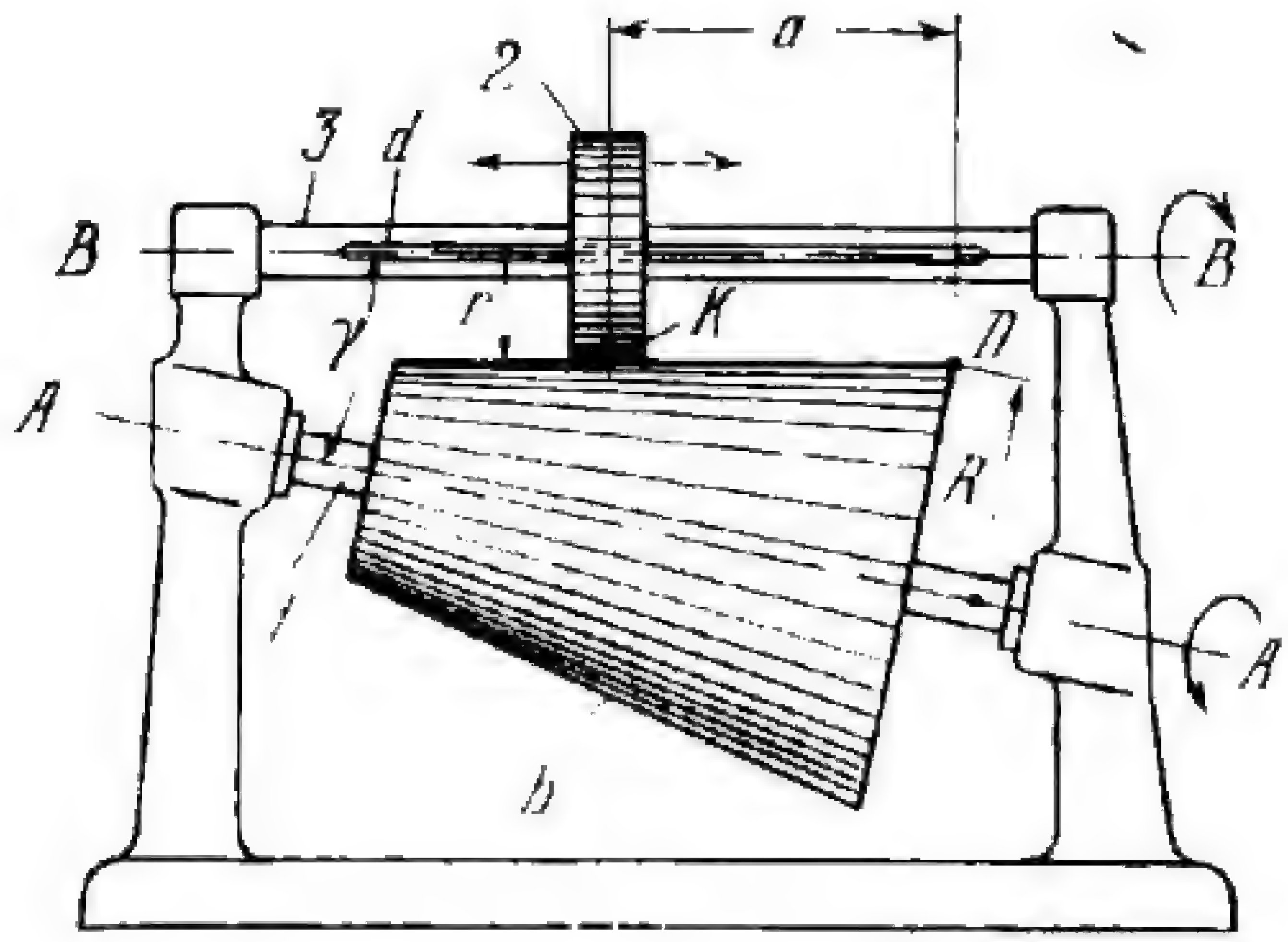


Friction cone b is keyed to shaft 1 and rotates about fixed axis A-A. Roller 2 can slide along shaft 3 on feather key d, rotates with this shaft about fixed axis B-B and is in contact at point K with cone b. Angle γ between axes A-A and B-B is equal to one half of the apex angle of cone b. Roller 2 is traversed along an element of the cone by screw 5 which rotates about fixed axis C-C and is connected by a screw pair to carriage 4 holding roller 2. The transmission ratio from shaft 1 to shaft 3 is

$$i_{13}=\frac{\omega_1}{\omega_3}=\frac{n_1}{n_3}=\frac{2\pi r}{2\pi R-\varphi h \sin\gamma}$$

where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of shafts 1 and 3, r is the radius of roller 2, R is the radius of the cross section of cone b passing through point D and perpendicular to axis A-A, h is the pitch of screw 5, and φ is the angle through which screw 5 is turned to traverse roller 2 from point D at the large end of the cone to point K.

3474	SINGLE FRICTION CONE-AND-ROLLER INFINITELY VARIABLE DRIVE MECHANISM	CF IV

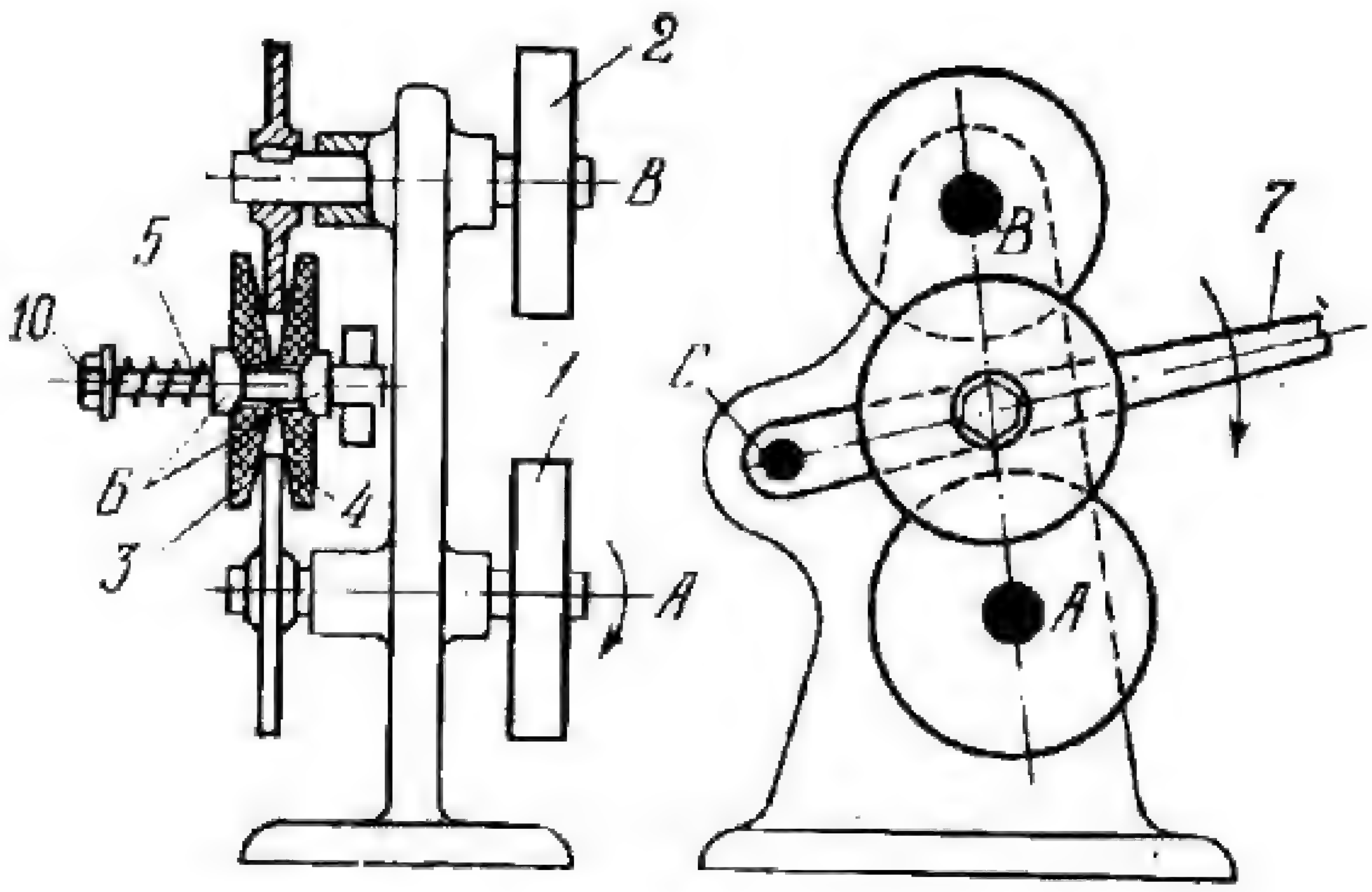


Friction cone *b* is keyed to shaft *1* and rotates about fixed axis *A-A*. Roller *2* can slide along shaft *3* on feather key *d*, rotates with this shaft about fixed axis *B-B* and is in contact at point *K* with cone *b*. Angle γ between axes *A-A* and *B-B* is equal to one half of the apex angle of cone *b*. The transmission ratio from shaft *1* to shaft *3* is

$$i_{13}=\frac{\omega_1}{\omega_3}=\frac{n_1}{n_3}=\frac{r}{R-a\sin\gamma}$$

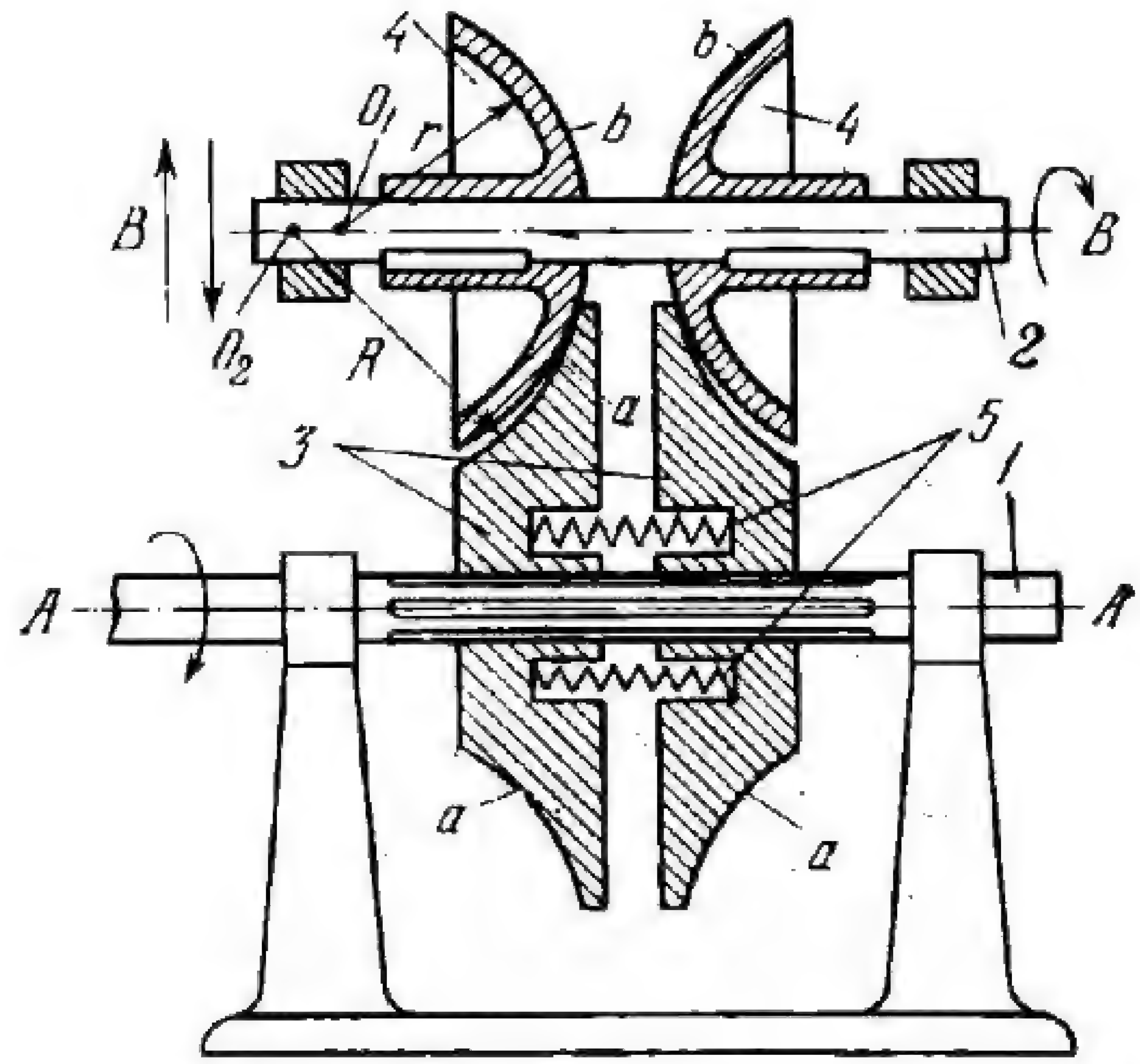
where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of shafts *1* and *3*, *r* is the radius of roller *2*, *a* is the variable distance from point *K* in the central cross section of roller *2* to point *D* at the large end of cone *b*, and *R* is the radius of the large end of the cone.

3475	FRICTION INFINITELY VARIABLE DRIVE MECHANISM WITH TWO TAPERED DISKS	CF IV



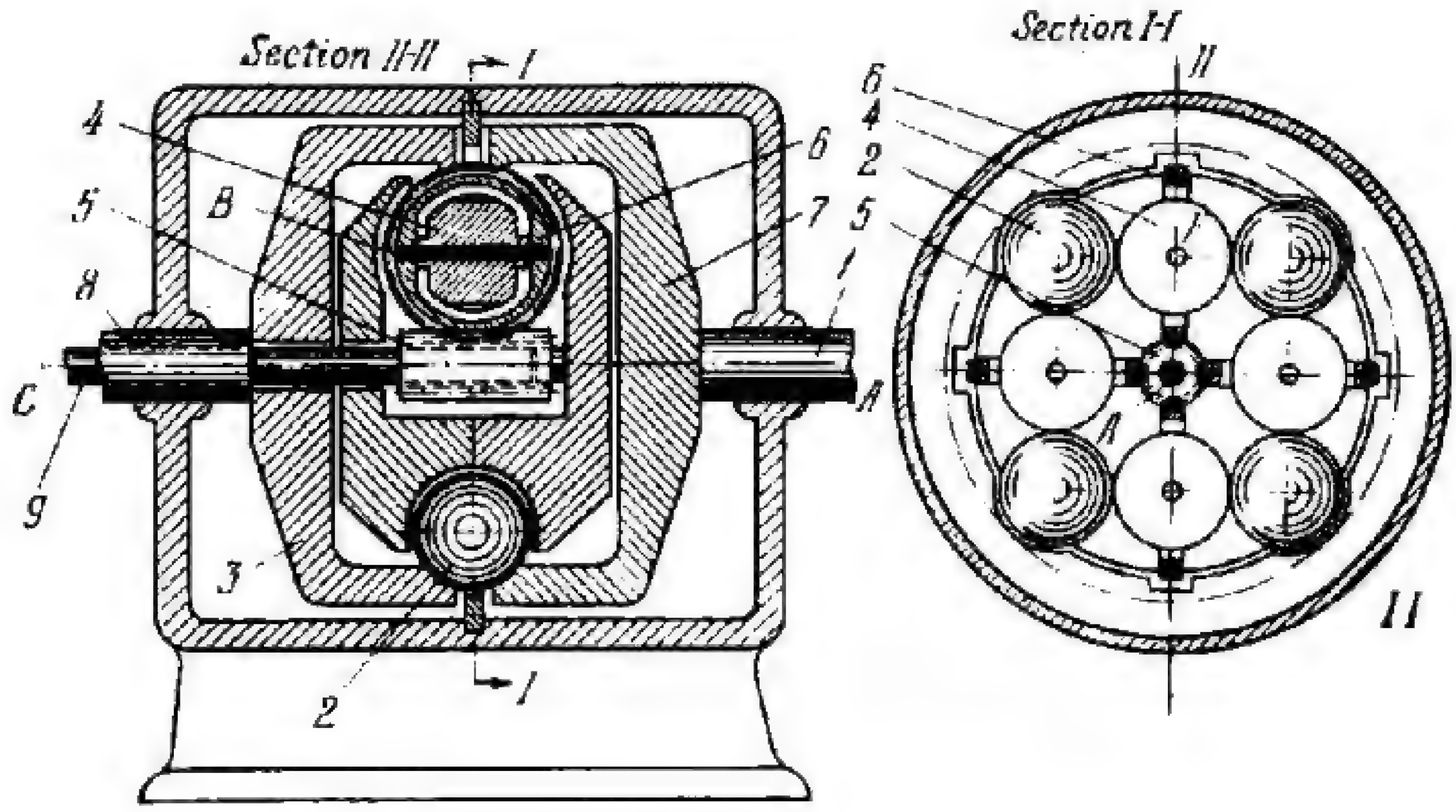
When pulley *1* rotates about fixed axis *A*, rotation is transmitted to pulley *2* about fixed axis *B* through two tapered disks *3* and *4* which are pressed by spring *5* and two spherical washers *6* against two identical disks keyed on the shafts of pulleys *1* and *2*. Tapered disks *3* and *4* are mounted with a certain clearance on axle *10* so that they rotate freely and can be tilted on the axle. Axle *10* is mounted in lever *7* which turns about fixed axis *C*. When lever *7* is turned, the distances between the axis of tapered disks *3* and *4* and axes *A* and *B* vary, thereby providing for stepless variation of the transmission ratio from pulley *1* to pulley *2*.

3476	PARALLEL-SHAFT FRICTION WHEEL INFINITELY VARIABLE DRIVE MECHANISM	CF IV



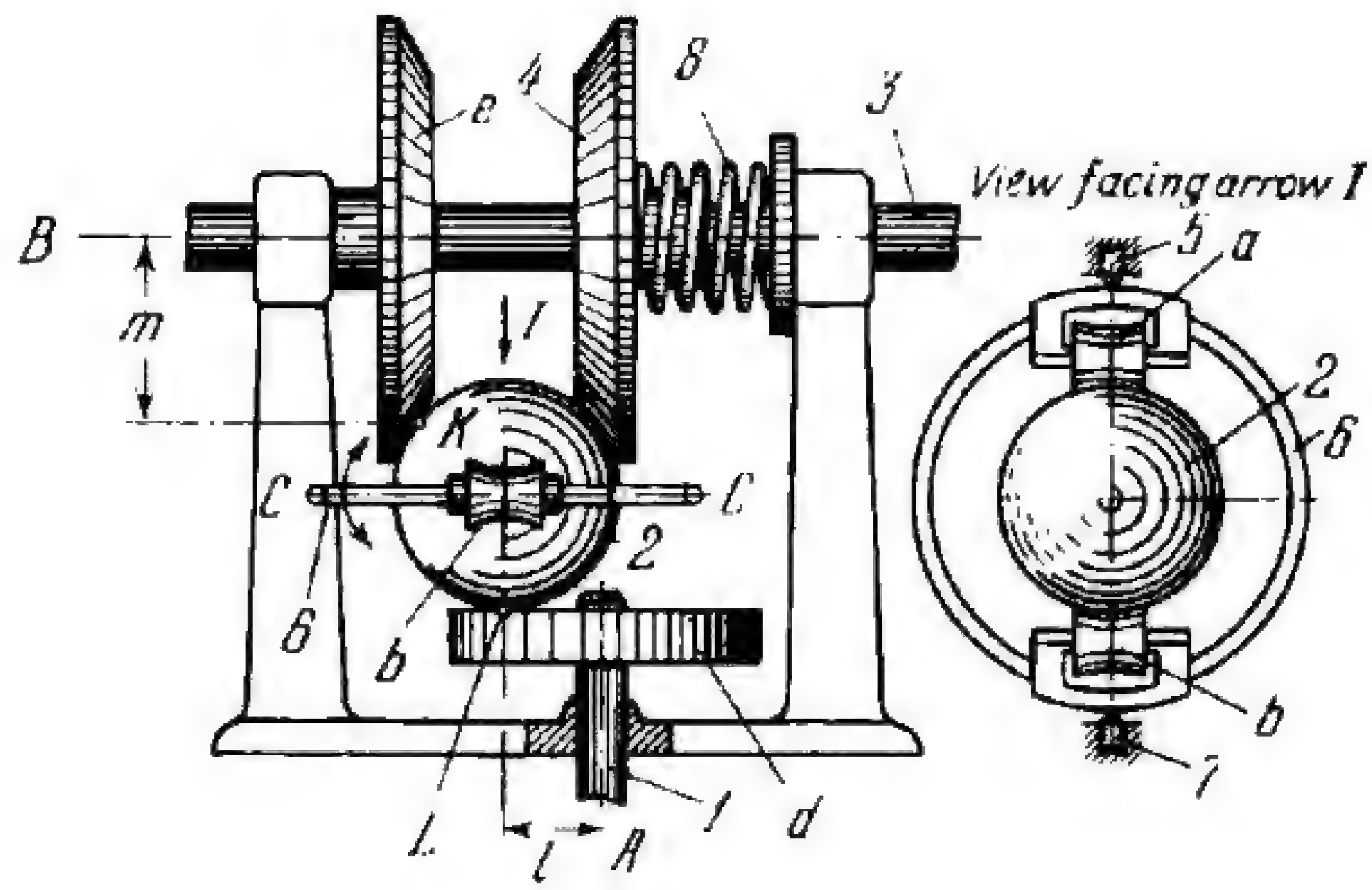
Identical toroidal friction wheels *3* are mounted on the splines of shaft *1* and rotate about fixed axis *A-A*. Identical spherical friction wheels *4* are keyed to shaft *2* and rotate about fixed axis *B-B*. The generatrix *a* of wheels *3* is a circular arc of radius *R* described from point O_2 lying on axis *B-B* in its extreme upper position. The generatrix *b* of wheels *4* is a circular arc of radius *r* described from point O_1 lying on axis *B-B*. Radius *R* is somewhat larger than radius *r*. The transmission ratio is varied by vertical displacement of axis *B-B*. Springs *5* tend to push wheels *3* apart along the splines of shaft *1*; thereby holding them in engagement with wheels *4*.

3477	FRICTION BALL INFIN ELY VARIABLE DRIVE MECHANISM	CF IV



Shaped cylinder *7* is keyed to shaft *1* and rotates about fixed axis *A*. Its rotation is transmitted by balls *2* to shaped cylinder *3* which is keyed to shaft *8* and rotates about fixed axis *C*. The direction of the axes of rotation of balls *2* and, therefore, the transmission ratio from the driving to the driven shaft depends upon the angle of inclination of axes *B* of guide rollers *4*. When worm *5*, keyed to shaft *9* is turned, worm wheels *6* are turned through a certain angle and thereby change the angle of inclination of axes *B* of rollers *4*. The axes of the rollers remain, however, in planes passing through axes *A* and *C*.

FRICTION TAPERED-DISK-AND-BALL INFINITELY VARIABLE DRIVE MECHANISM



Flat disk d is keyed to shaft 1 and rotates about fixed axis A. Rotation is transmitted from disk d through ball 2 to tapered disk e which is keyed to shaft 3 and rotates about fixed axis B. Tapered disk 4 rotates freely on shaft 3 and, by means of spring 8, develops the pressure required to transmit torque in the mechanism. Ball 2, subject to the pressure of concave rollers a and b, forced against the ball by screws 5 and 7, can rotate only about axis C-C. The angle of inclination of axis C-C of rotation of ball 2 can be varied by tilting frame 6 as shown by the arrows. This provides stepless variation of the transmission ratio between shaft 1 and shaft 3. Spring 8 holds disks e, 4 and d in constant contact with ball 2. The transmission ratio from shaft 1 to shaft 3 is

$$i_{13}=\frac{\omega_1}{\omega_3}=\frac{n_1}{n_3}=\frac{m}{l}\cos\varphi$$

where ω_1, ω_3, n_1 and n_3 are the angular velocities and speeds (in rpm) of shafts 1 and 3, m and l are the constant distances from points K and L of contact between ball 2 and disks e and d to axes B and A, and φ is the variable angle of tilt of axis C-C.

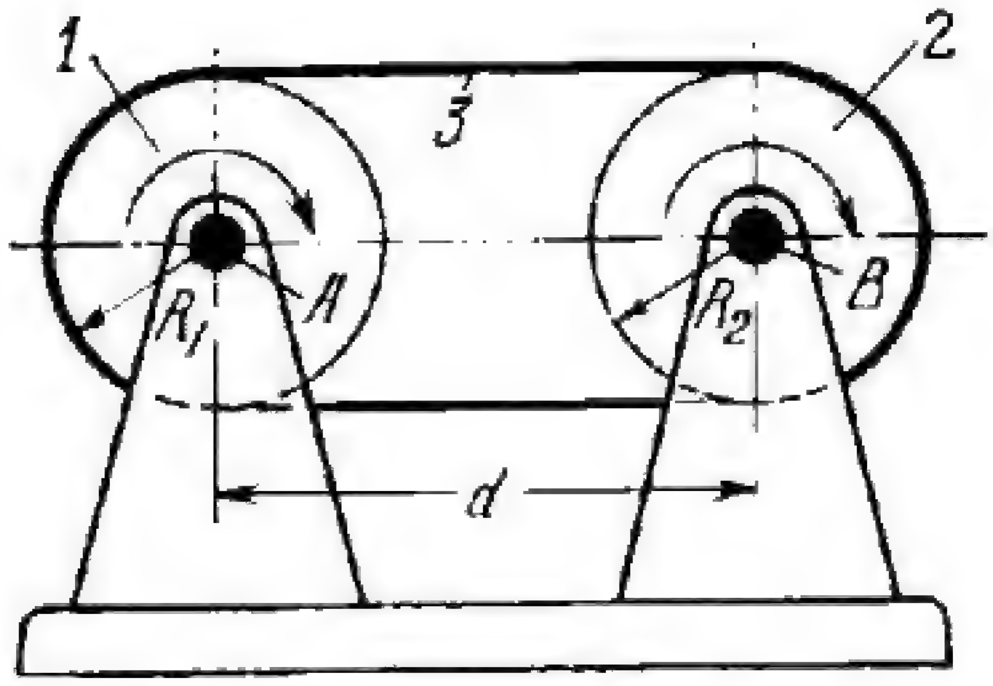
SECTION TWENTY-SIX

Simple Flexible-Link Mechanisms SFL

1. General-Purpose Four-Link Mechanisms 4L (3479 through 3492)
2. General-Purpose Multiple-Link Mechanisms ML (3493 through 3503)
3. Belt Drive Mechanisms BD (3504 through 3517)
4. Mechanisms of Materials Handling Equipment MH (3518 through 3521)
5. Mechanisms of Measuring and Testing Devices M (3522 through 3526)
6. Brake Mechanisms Br (3527 and 3528)
7. Mechanisms of Other Functional Devices FD (3529, 3530 and 3531)

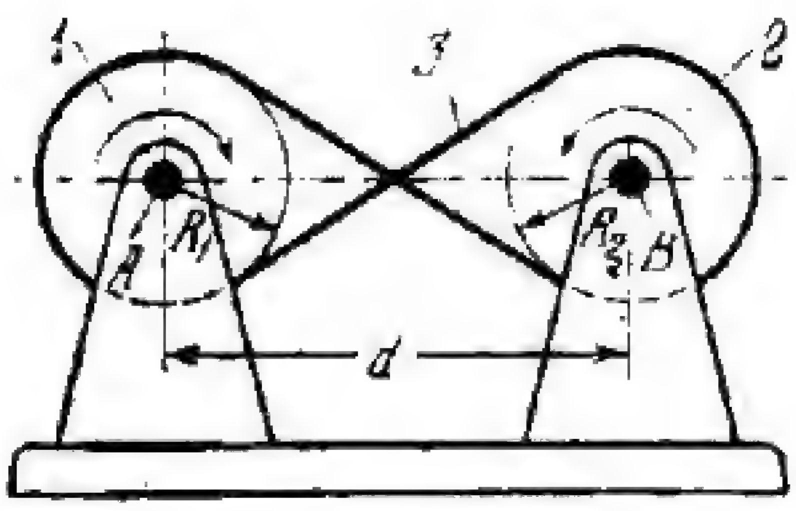
1. GENERAL-PURPOSE FOUR-LINK MECHANISMS (3479 through 3492)

3479	FOUR-LINK OPEN FLEXIBLE LINK DRIVE MECHANISM	SFL 4L



Pulleys *1* and *2* rotate about fixed axes A and B. Rotation is transmitted from pulley *1* to pulley *2* through open flexible link *3*. Radii R_1 and R_2 of the pulleys are equal. The transmission ratio from pulley *1* to pulley *2* is $i_{12} = \frac{\omega_1}{\omega_2} = \frac{n_1}{n_2} = 1$, where ω_1, ω_2, n_1 and n_2 are the angular velocities and speeds (in rpm) of pulleys *1* and *2*. The length of the flexible link is $L = 2(\pi R + d)$, where d is the distance between axes A and B, and $R = R_1 = R_2$.

3480	FOUR-LINK CROSSED FLEXIBLE LINK DRIVE MECHANISM	SFL 4L

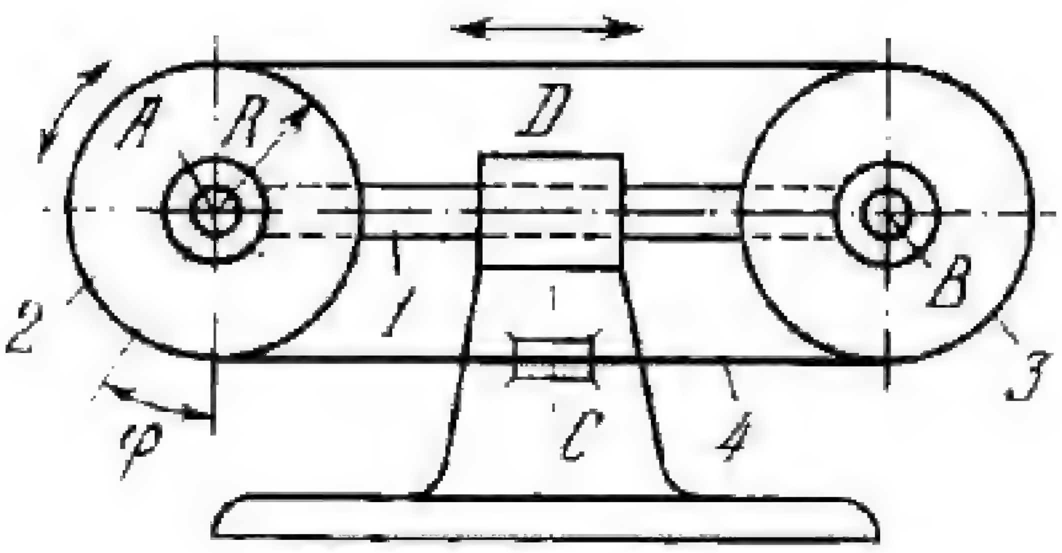


Pulleys *1* and *2* rotate about fixed axes A and B. Rotation is transmitted from pulley *1* to pulley *2* through crossed flexible link *3*. Radii R_1 and R_2 of the pulleys are equal. The transmission ratio from pulley *1* to pulley *2* is $i_{12} = \frac{\omega_1}{\omega_2} = -\frac{n_1}{n_2} = -1$, where ω_1, ω_2, n_1 and n_2 are the angular velocities and speeds (in rpm) of pulleys *1* and *2*. The length of the flexible link is

$$L = 2\pi R + 4R \arcsin \frac{2R}{d} + 2\sqrt{d^2 - 4R^2}$$

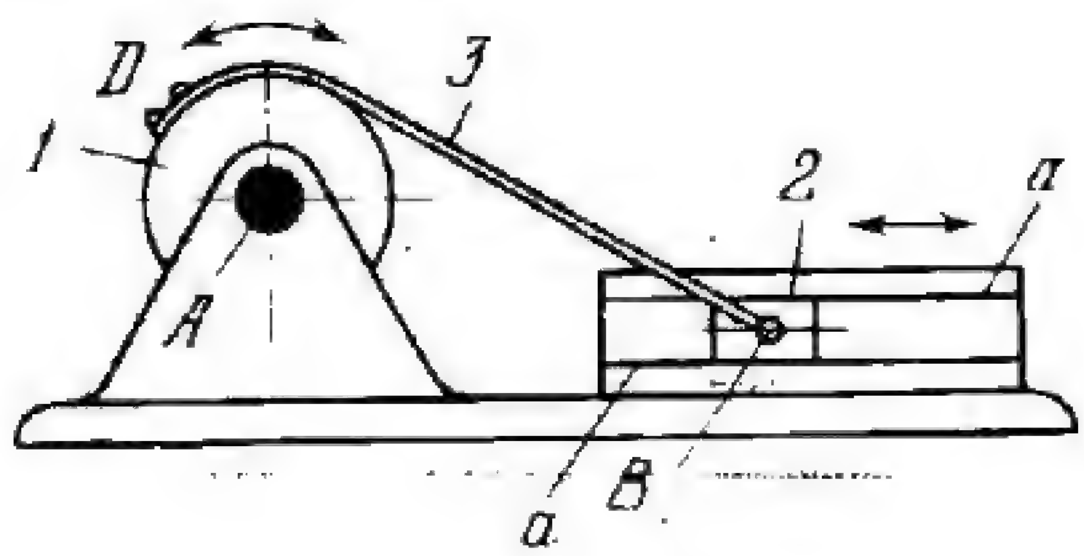
where d is the distance between axes A and B, and $R = R_1 = R_2$.

3481	PLANETARY FLEXIBLE-LINK SLIDE DRIVE MECHANISM	SFL 4L



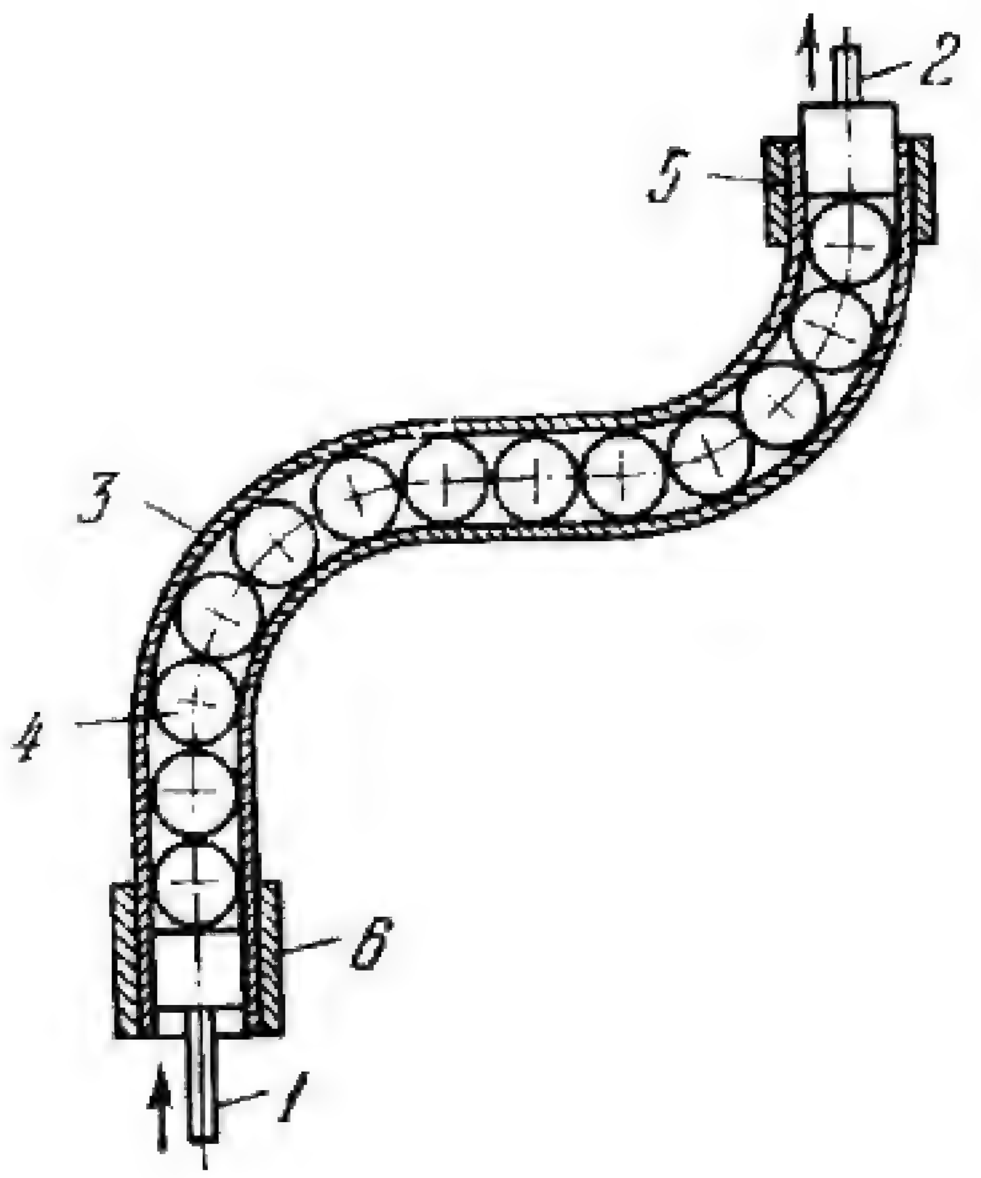
Two identical pulleys *2* and *3* rotate about axes *A* and *B* of slide *1* which reciprocates in fixed guide *D*. Flexible link *4* runs over pulleys *2* and *3*, and is rigidly attached to the base at point *C*. When slide *1* is moved, the pulleys roll along the flexible link. When one of the pulleys is turned, the displacement of slide *1* is $s = R\varphi$, where R is the radius of the pulleys and φ is the angle through which the pulley is turned.

3482	FLEXIBLE-LINK SLIDER DRIVE MECHANISM	SFL 4L



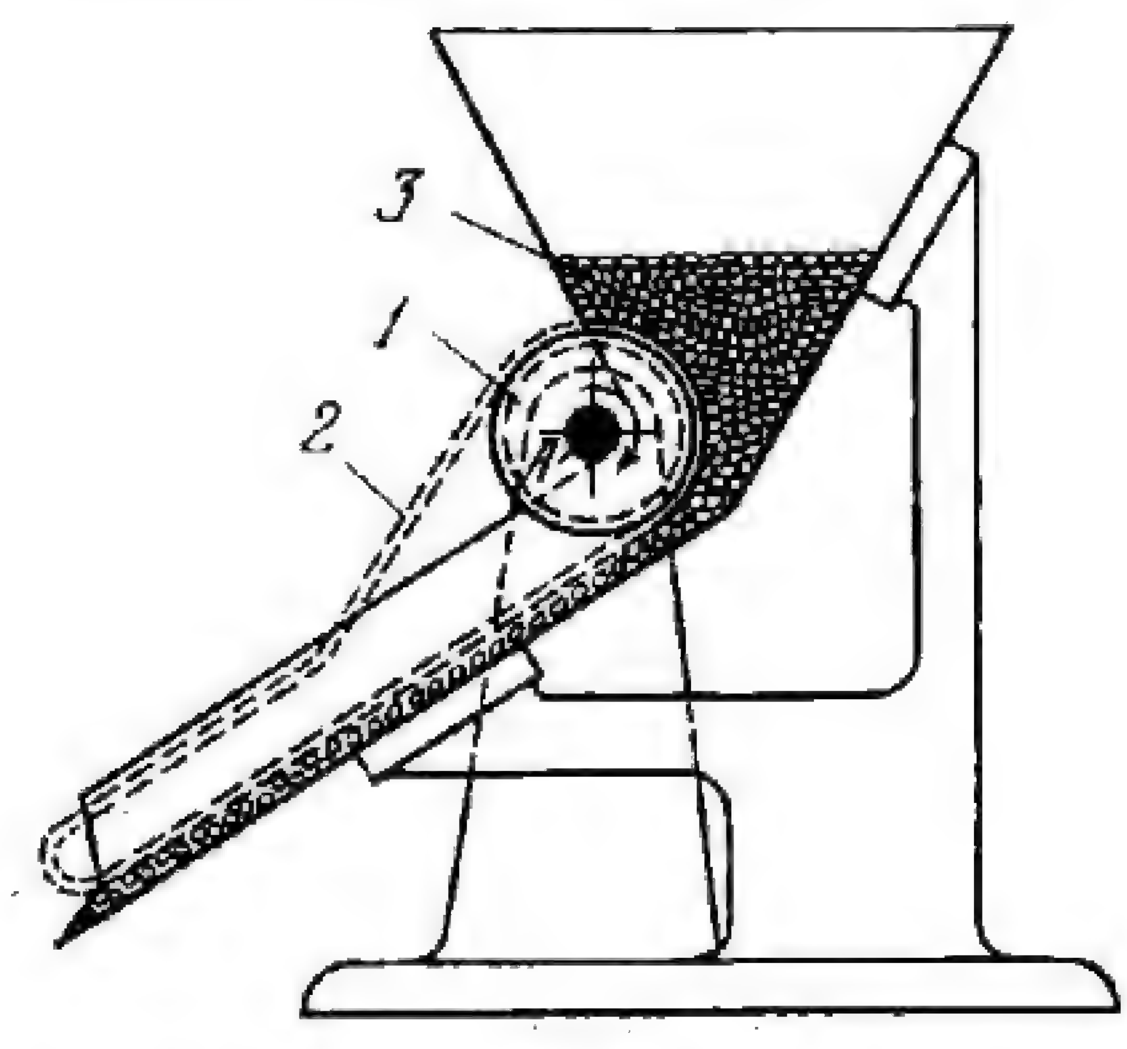
Pulley *1* turns about fixed axis *A*. Flexible link *3*, usually designed as a steel belt, is attached at one end to pulley *1* at point *D*. At its other end, link *3* is connected by turning pair *B* to slider *2* which reciprocates in fixed guides *a-a*. When pulley *1* oscillates, slider *2* moves to the left when the pulley turns counterclockwise, and to the right when the pulley turns clockwise if the flexible link is sufficiently stiff. If not, pulley *1* is returned to its initial position by shifting slider *2* to the right.

3483	STEEL BALL FLEXIBLE DRIVE MECHANISM	SFL · 4L



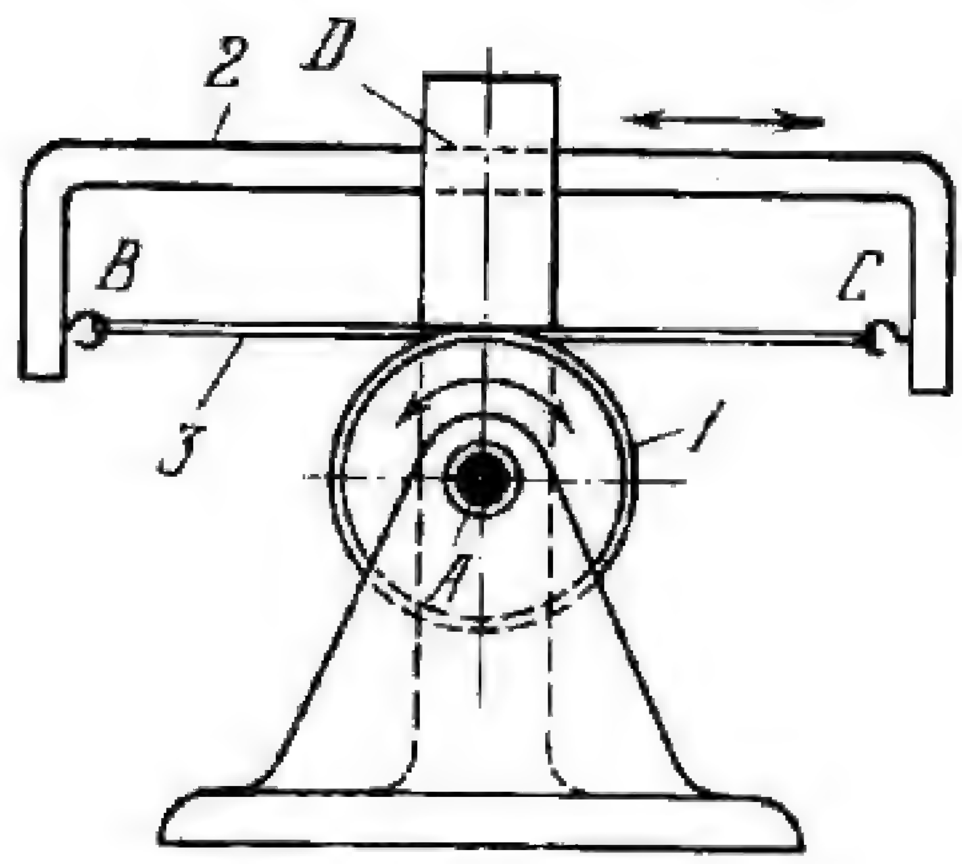
Flexible tube *3* is filled with identical steel balls *4*. One end of tube *3* is attached in fixed cylinder *5* and the other end in fixed cylinder *6*. When piston *1* is pushed into cylinder *6*, motion is transmitted to piston *2* in cylinder *5*. The centre line of flexible tube *3* between the cylinders may be of various shapes. The mechanism can be used for spatial transmission of motion.

3484	FEEDING MECHANISM FOR LOOSE MATERIALS	SFL · 4L



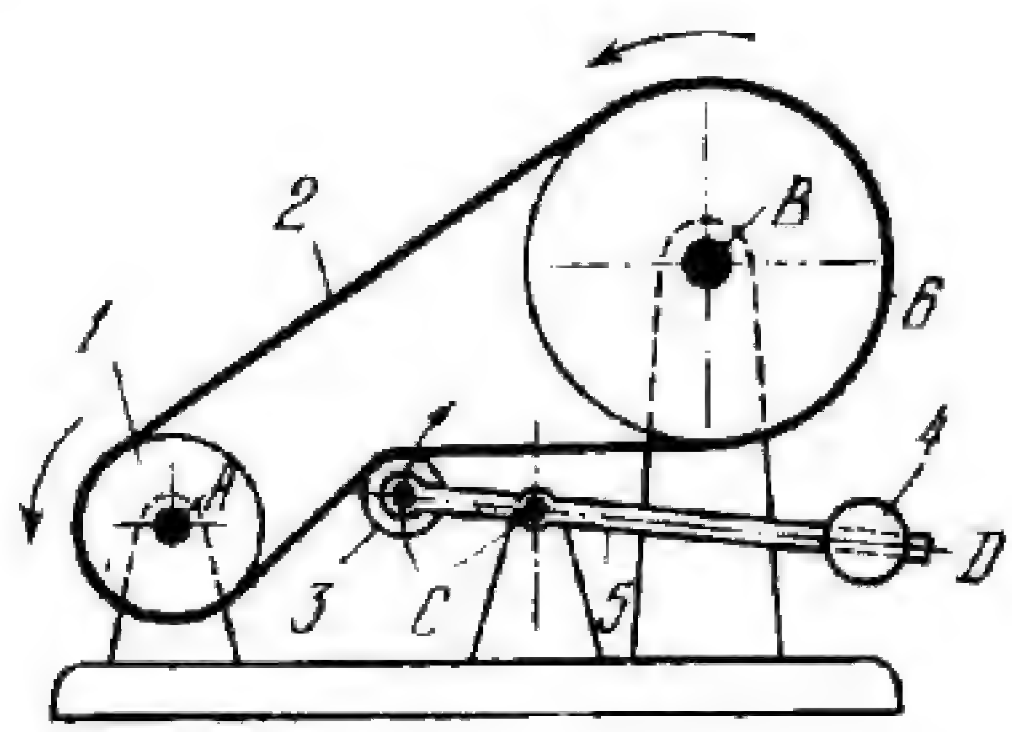
Chain sheave *1* rotates about fixed axis *A*. Heavy endless chain *2* runs over sheave *1*. When sheave *1* rotates clockwise, chain *2* controls the flow of loose material fed out of hopper *3*.

3485	FLEXIBLE-LINK SLIDE-DRIVEN PULLEY MECHANISM	SFL 4L



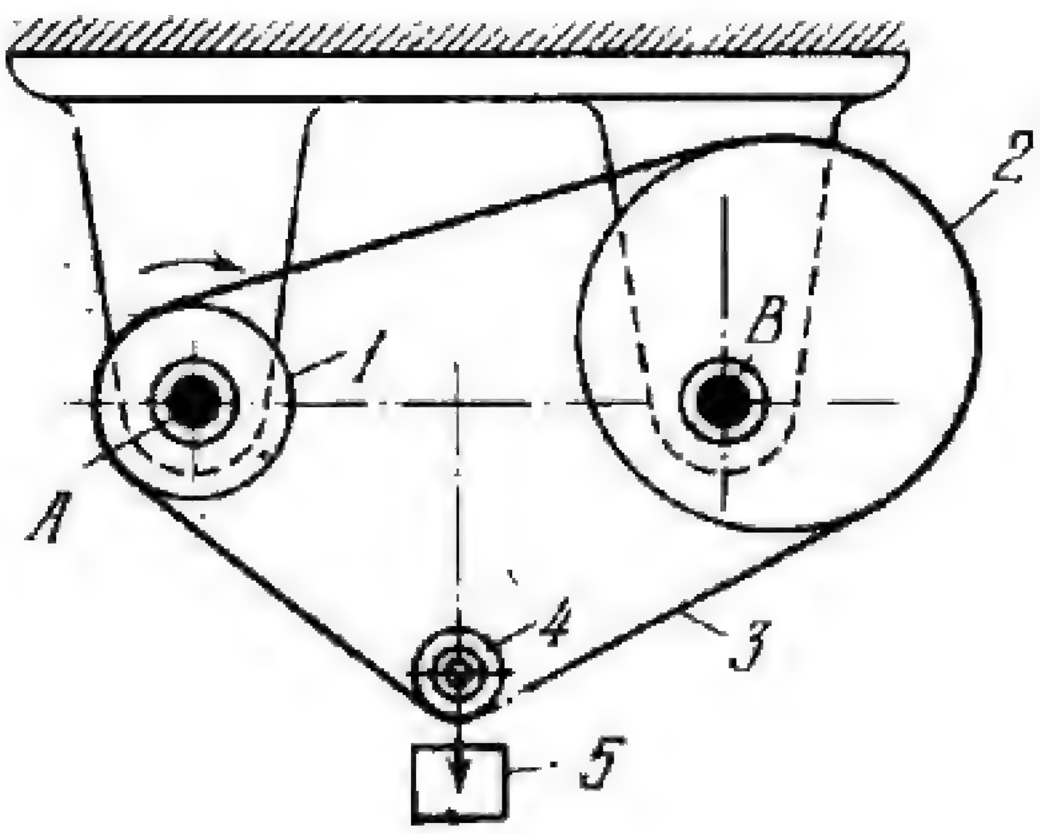
Pulley 1 rotates about fixed axis A. Flexible link 3 runs 360° around pulley 1 and its ends are secured at points B and C to slide 2 which reciprocates in fixed guide D. When slide 2 reciprocates, pulley 1 oscillates about axis A.

3486	FLEXIBLE-LINK DRIVE MECHANISM WITH AN IDLER PULLEY	SFL 4L



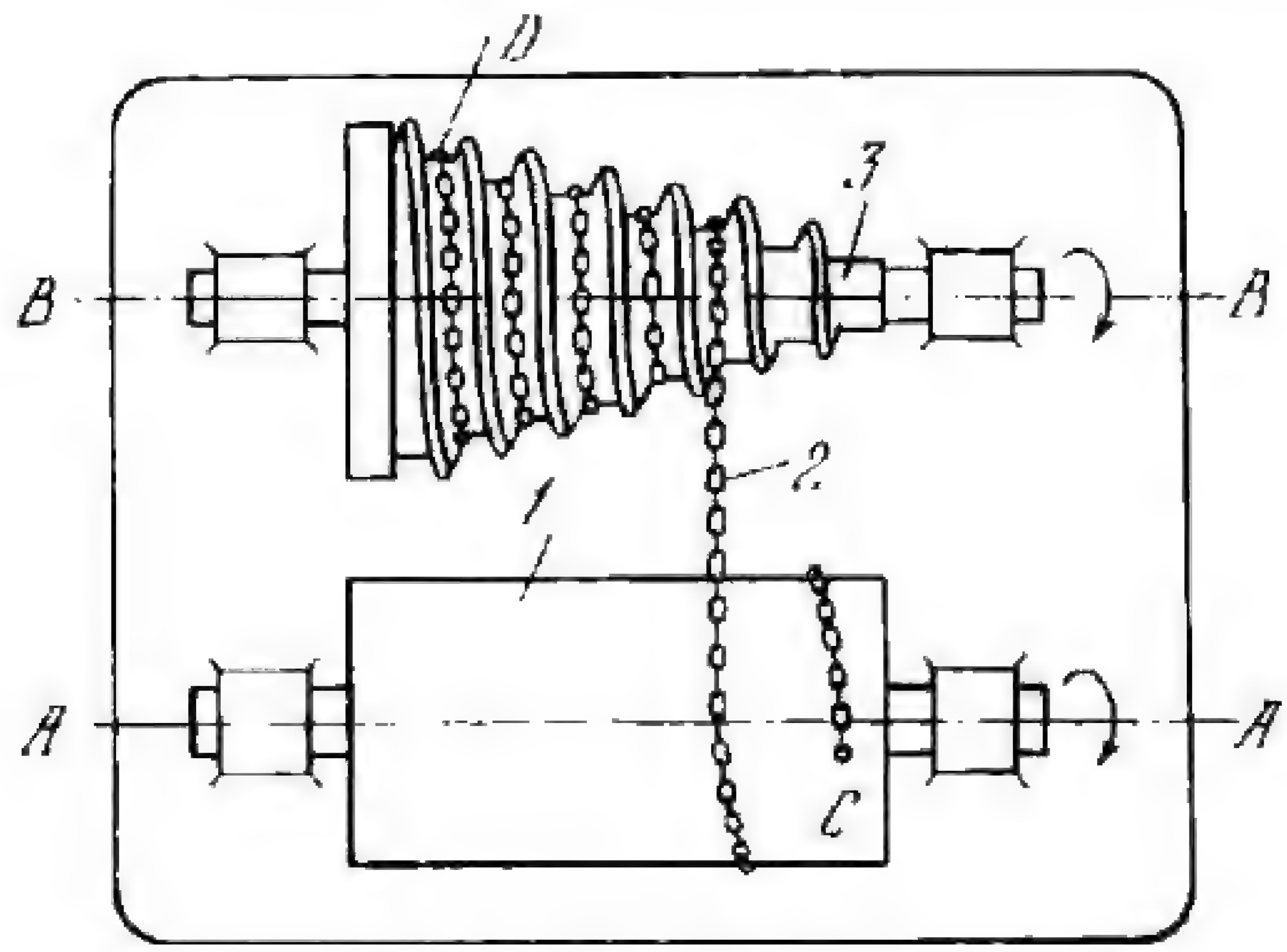
Pulleys 1 and 6 rotate about fixed axes A and B. Flexible link 2 runs over pulleys 1 and 6. Lever 5 turns about fixed axis C and carries idler pulley 3 which is held in constant contact with flexible link 2. Weight 4 can be adjusted along axis D of lever 5 and clamped in the required position to obtain the necessary tension of link 2.

3487	FLEXIBLE-LINK DRIVE MECHANISM WITH AN ECCENTRIC PULLEY	SFL 4L



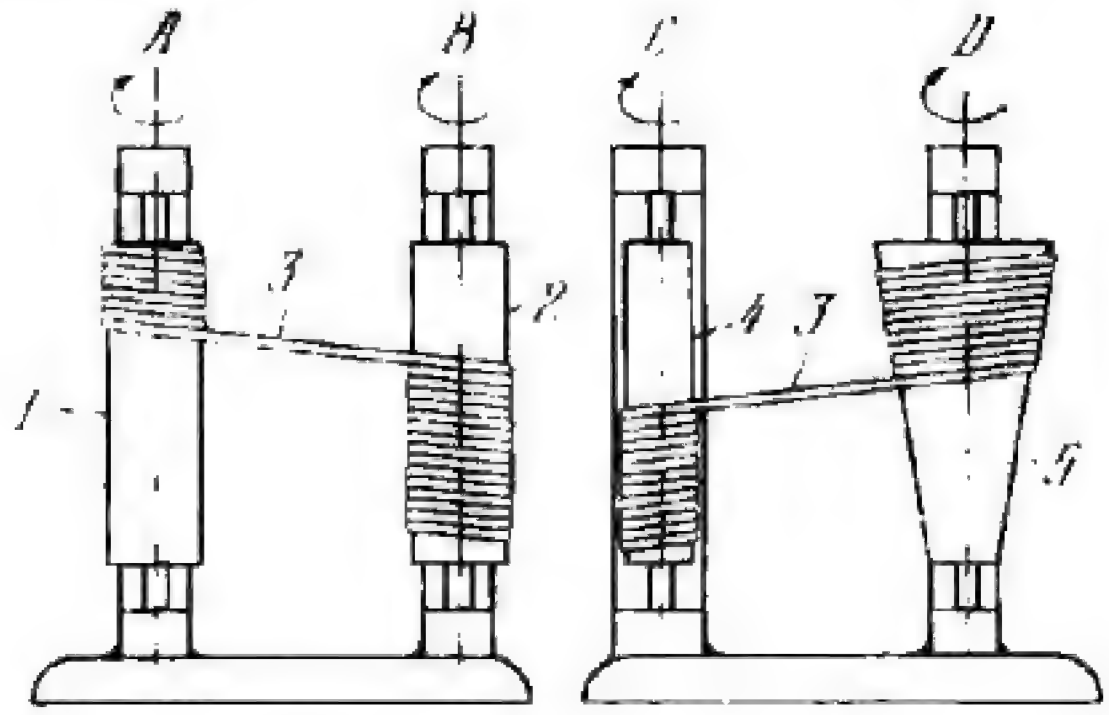
Pulleys *1* and *2* rotate about fixed axis *A* and about eccentrically located fixed axis *B*. Flexible link *3* runs over pulleys *1* and *2*, and freely suspended idler pulley *4* which is loaded by weight *5*. When pulley *1* rotates at uniform speed, pulley *2* rotates at nonuniform speed.

3488	CHAIN DRIVE MECHANISM WITH A SPIRAL CONICAL SHEAVE	SFL 4L



Drum *1* rotates about fixed axis *A-A*. Chain sheave *3* has a spiral conical groove and rotates about fixed axis *B-B*. One end of chain *2* is secured to drum *1* at point *C* and the other end to sheave *3* at point *D*. When drum *1* rotates at uniform speed, chain *2* is wound on the drum and unwound from sheave *3* which rotates at variable (gradually decreasing) speed.

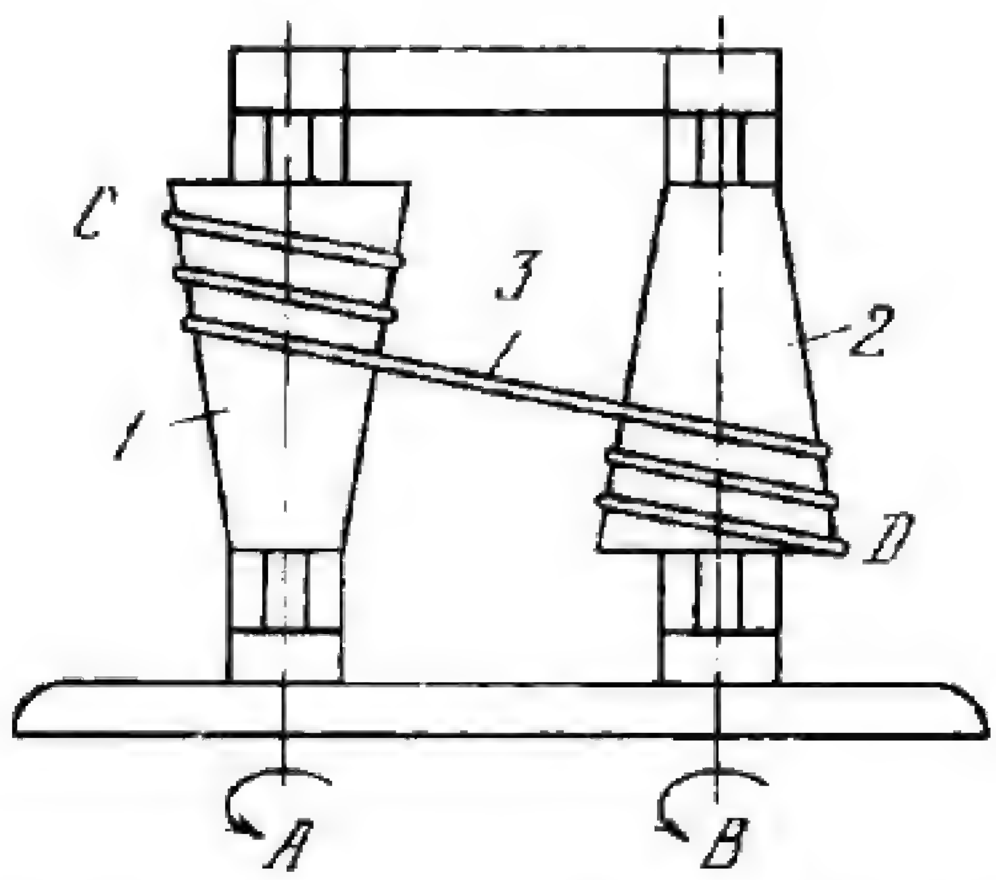
3489	BOBBIN REWINDING MECHANISM	SFL 4L



(a) (b)

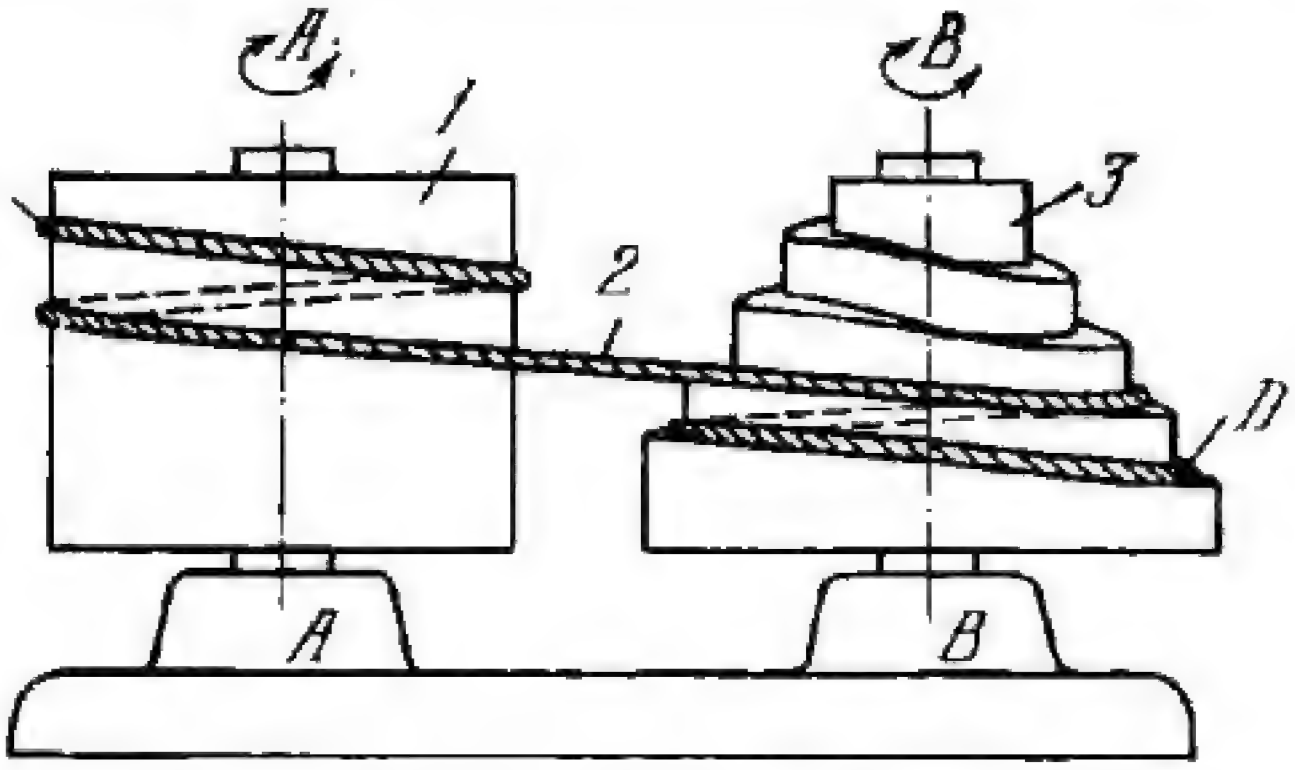
Cylindrical bobbins *1* and *2* (Fig. *a*) rotate about fixed axes *A* and *B*. The ends of flexible link *3* are secured to these bobbins. In Fig. *b*, flexible link *3* has the ends secured to cylindrical bobbin *4* and conical bobbin *5* which rotate about fixed axes *C* and *D*. When bobbin *1* rotates at uniform speed, link *3* is wound on bobbin *1* and unwound from bobbin *2* which also rotates at uniform speed (Fig. *a*). If bobbin *4* rotates at uniform speed, conical bobbin *5* rotates at nonuniform (gradually decreasing) speed (Fig. *b*).

3490	FLEXIBLE-LINK CONICAL PULLEY DRIVE MECHANISM	SFL 4L



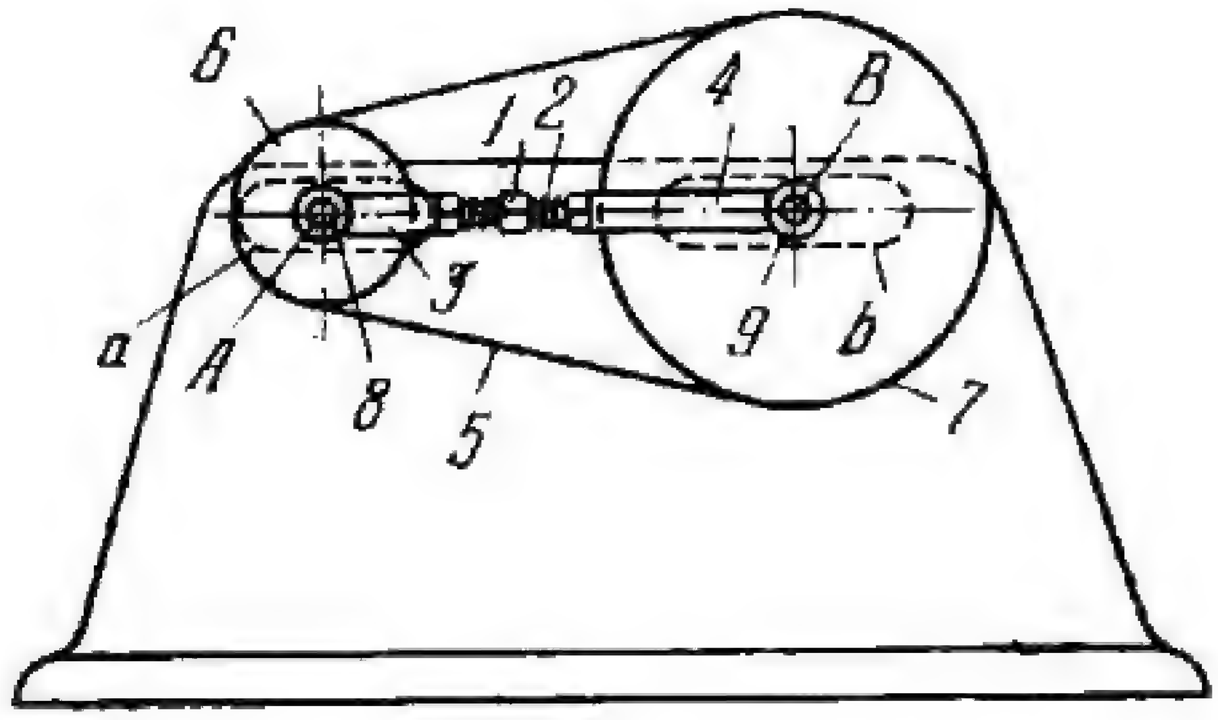
Two identical conical pulleys *1* and *2* rotate about fixed axes *A* and *B*. One end *C* of flexible link *3* is secured to pulley *1* and the other end, *D*, to pulley *2*. When pulley *1* rotates at uniform speed, flexible link *3* is wound on pulley *1* and unwound from pulley *2*, and the latter has variable (gradually decreasing) speed because of the varying transmission ratio.

3491	FLEXIBLE-LINK DRIVE MECHANISM WITH A SPIRAL CONICAL PULLEY	SFL 4L



Pulley *1* rotates about fixed axis *A-A*. Pulley *3* has a spiral conical working surface and rotates about fixed axis *B-B*. One end of flexible link *2* is secured to pulley *1* at point *C* and the other end to pulley *3* at point *D*. When pulley *1* rotates at uniform speed, pulley *3* rotates at a nonuniform speed whose variation depends upon the profile of the spiral conical working surface. After the flexible link has been wound from pulley *3* onto pulley *1*, pulley *3* becomes the driving link. Thus rotation of pulleys *1* and *3* is periodically reversed.

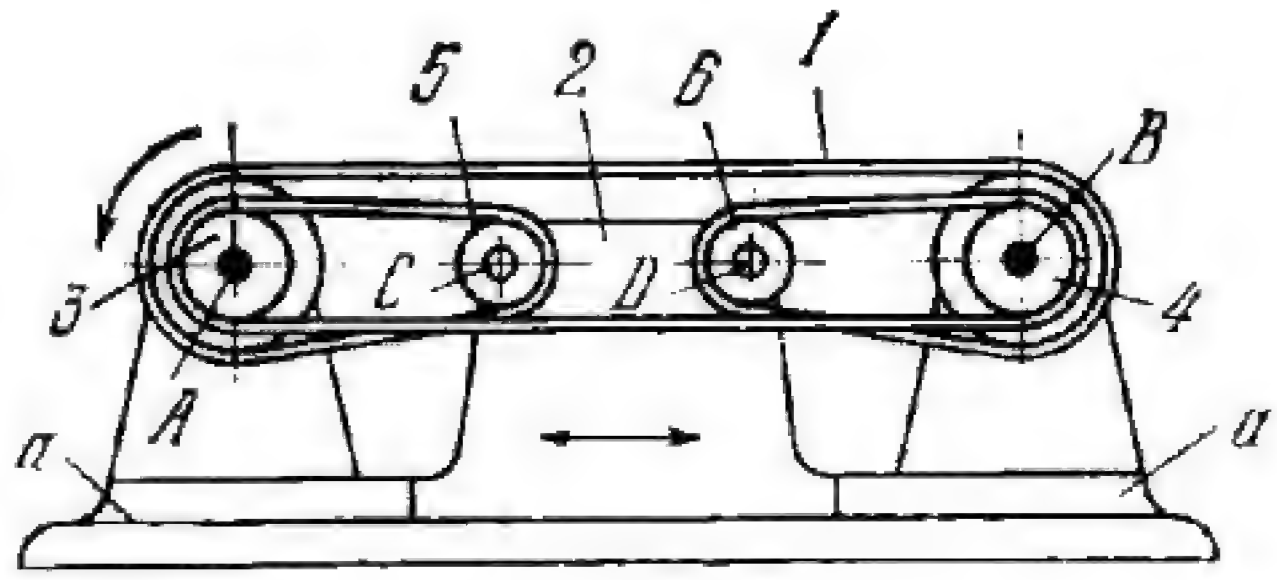
3492	FLEXIBLE-LINK DRIVE MECHANISM WITH SCREW TENSION ADJUSTMENT	SFL 4L



Pulleys *6* and *7* rotate about axes *A* and *B* of axles *8* and *9*. These axles are connected by turning pairs to links *3* and *4* which can slide in fixed guides *a* and *b*. Screw *2* has right- and left-hand threads and is connected by screw pairs to links *3* and *4*. When head *1* of screw *2* is turned, the distance between axes *A* and *B* is varied to obtain the required tension of flexible link *5* which runs over pulleys *6* and *7*.

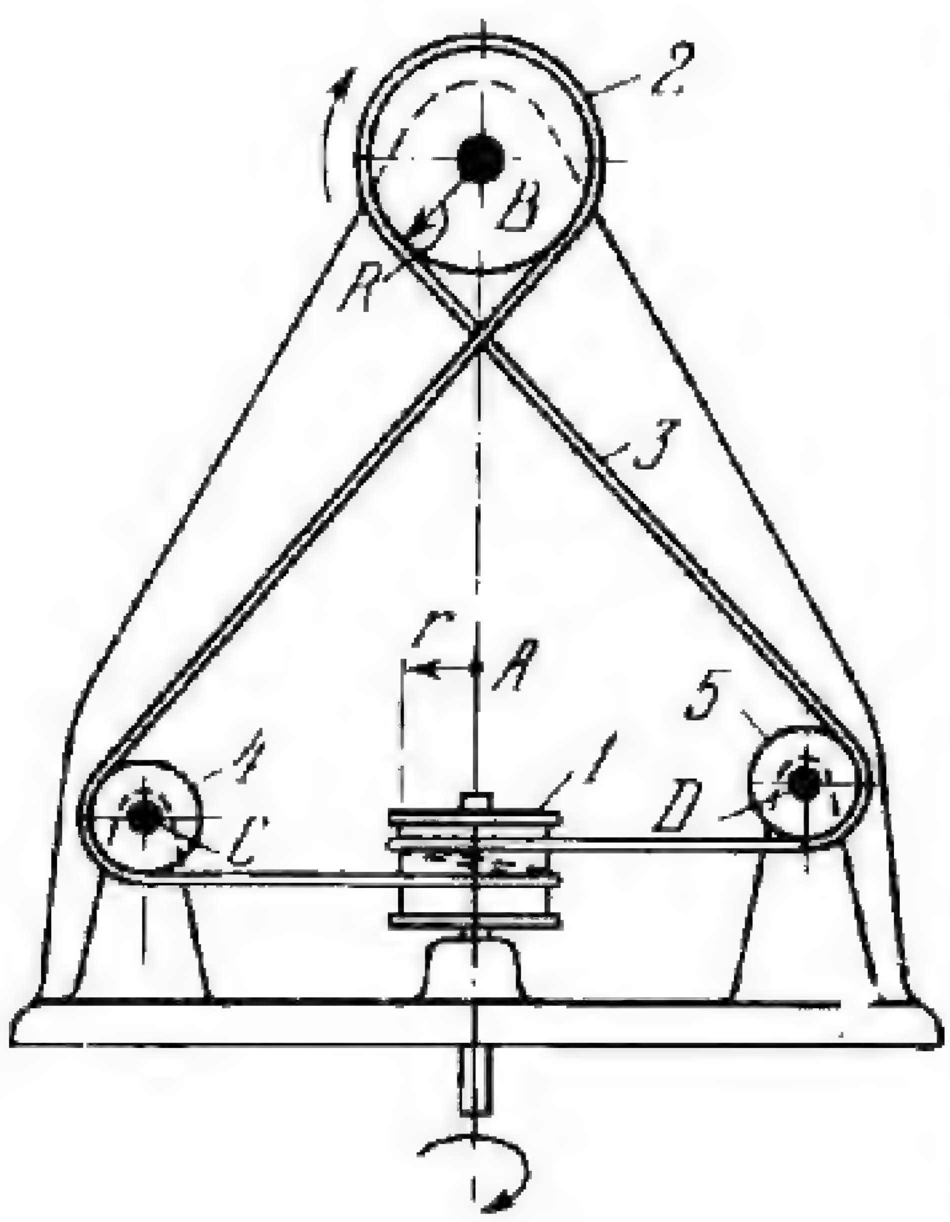
2. GENERAL-PURPOSE MULTIPLE-LINK MECHANISMS (3493 through 3503)

3493	FLEXIBLE-LINK DIFFERENTIAL SLIDE MECHANISM	SFL ML



Two identical two-stepped pulleys *3* and *4* rotate about fixed axes *A* and *B*. Flexible link *1* runs over both steps of pulleys *3* and *4*, and rollers *5* and *6* which rotate about axes *C* and *D* of slide *2*. Slide *2* reciprocates along fixed guides *a-a*. The mechanism allows slide *2* to be moved to various positions along guides *a-a* without changing the motion of flexible link *1*.

3494	SPATIAL DRIVE MECHANISM WITH A CROSSED FLEXIBLE LINK	SFL ML

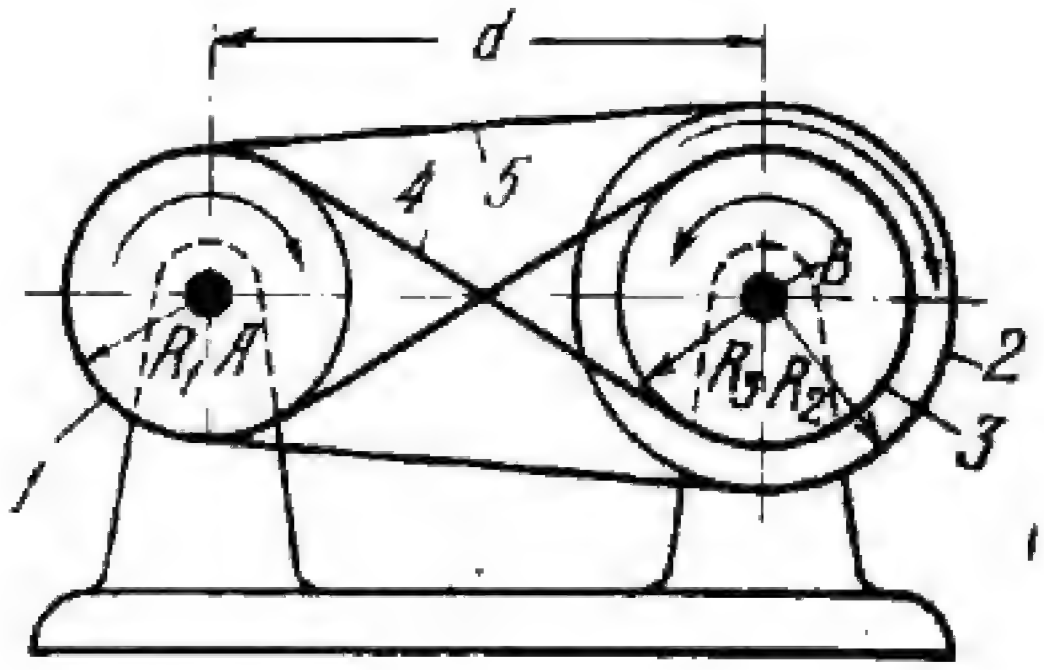


Reel *1* rotates about fixed axis *A*. Crossed flexible link *3* runs 360° around reel *1*, over pulley *2* and over two identical guide rollers *4* and *5*. Pulley *2* and rollers *4* and *5* rotate about fixed axes *B*, *C* and *D*. The mechanism transmits rotation between axes *A* and *B* which intersect at right angles. The transmission ratio between reel *1* and pulley *2* is

$$i_{12} = \frac{\omega_1}{\omega_2} = \frac{n_1}{n_2} = \frac{R}{r}$$

where ω_1, ω_2, n_1 and n_2 are the angular velocities and speeds (in rpm) of reel *1* and pulley *2*, *R* is the radius of pulley *2* and *r* is the radius of reel *1*.

3485	FLEXIBLE-LINK MECHANISM FOR DRIVING COAXIAL PULLEYS	SFL ML



Pulley *1* rotates about fixed axis A. Pulleys *2* and *3* rotate independently of each other about fixed axis B. Open flexible link *5* runs over pulleys *1* and *2*; crossed flexible link *4* runs over pulleys *1* and *3*. The transmission ratios from pulley *1* to pulleys *2* and *3* are

$$i_{12}=\frac{\omega_1}{\omega_2}=\frac{n_1}{n_2}=\frac{R_2}{R_1} \quad \text{and} \quad i_{13}=\frac{\omega_1}{\omega_3}=-\frac{n_1}{n_3}=-\frac{R_3}{R_1}$$

where ω_1, ω_2, ω_3, n_1, n_2 and n_3 are the angular velocities and speeds (in rpm) of pulleys *1*, *2* and *3*, and R_1, R_2 and R_3 are the radii of pulleys *1*, *2* and *3*. Under the condition that $R_2 > R_1$, the lengths of flexible links *4* and *5* equal

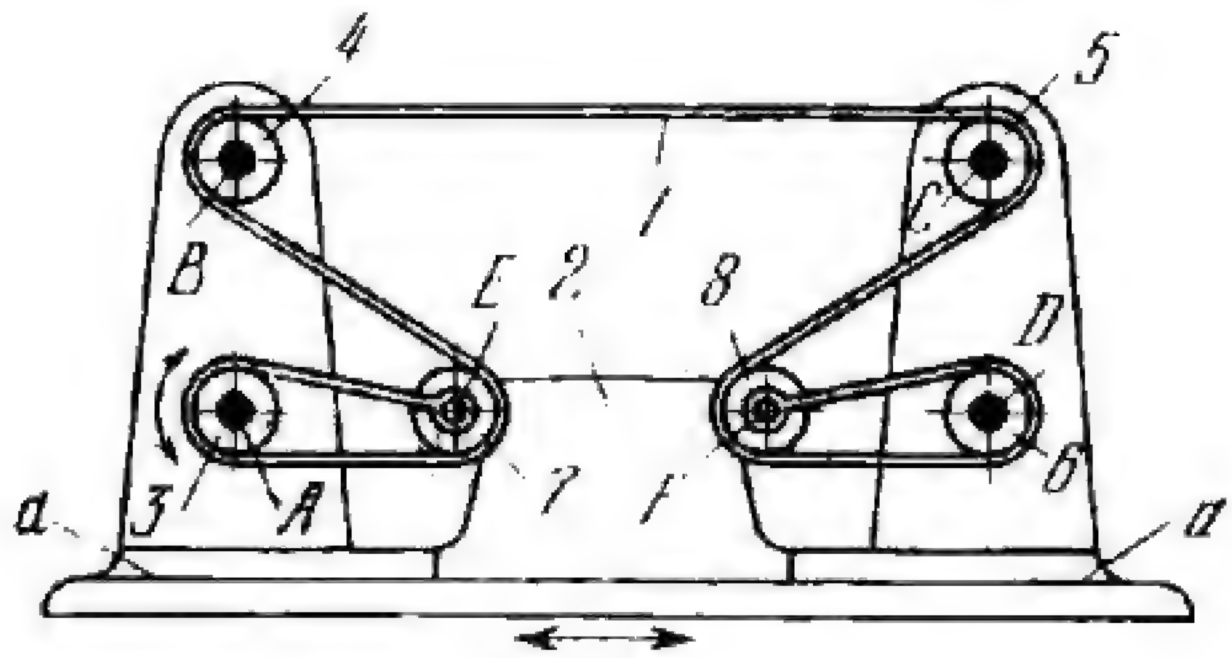
$$L_4=\left(\pi+2\arcsin\frac{R_1+R_3}{d}\right)(R_1+R_3)+2\sqrt{d^2+(R_1+R_3)^2}$$

and

$$L_5=\pi(R_1+R_2)+2(R_2-R_1)\arcsin\frac{R_2-R_1}{d}+2\sqrt{d^2-(R_2-R_1)^2}$$

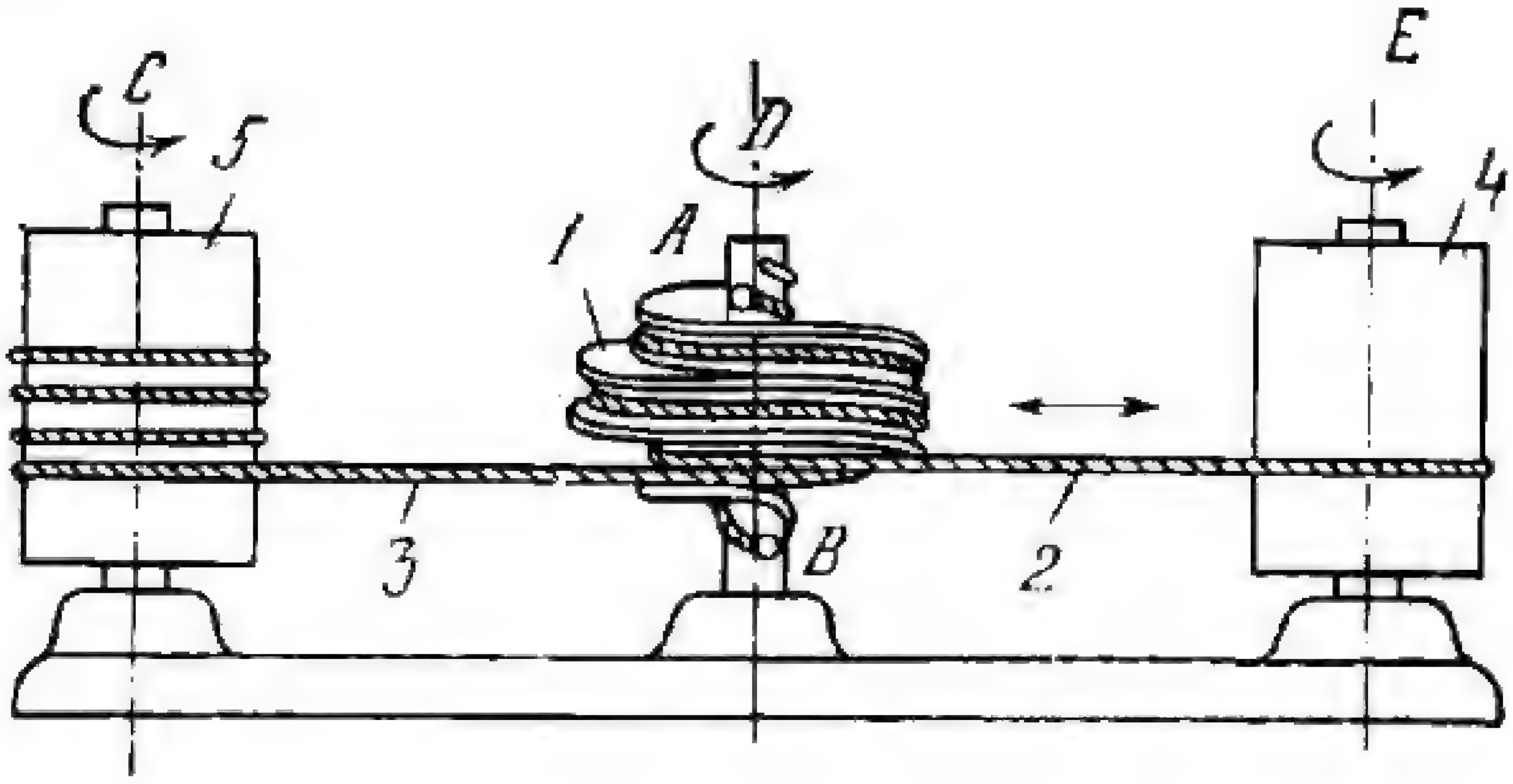
where d is the distance between axes A and B.

3496	FLEXIBLE-LINK SLIDE MECHANISM	SFL ML



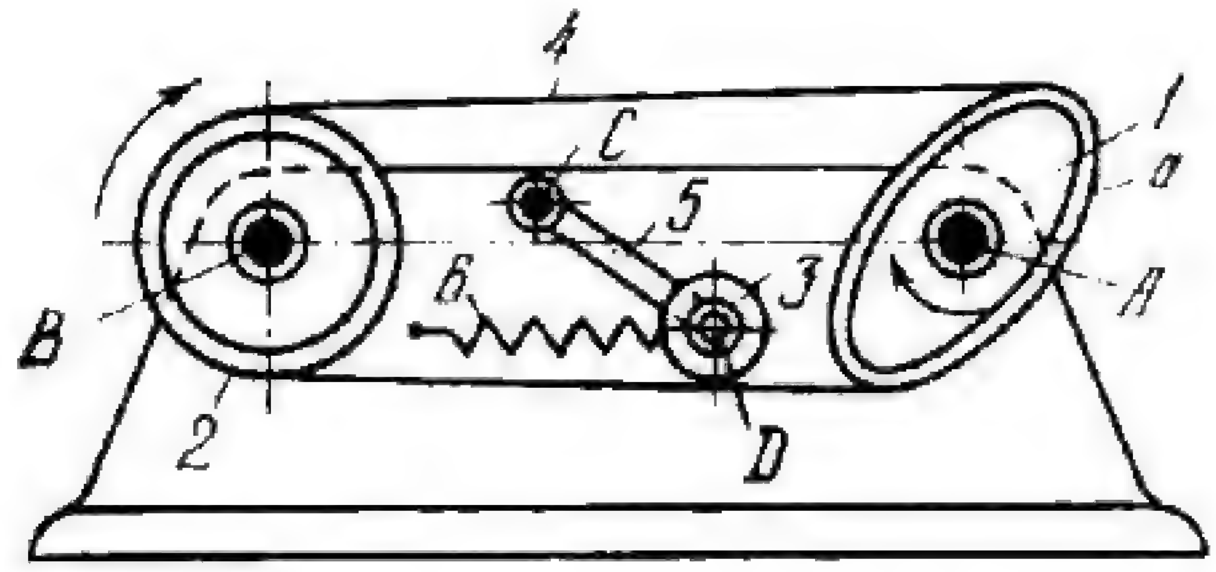
Four identical pulleys *3*, *4*, *5* and *6* rotate about fixed axes *A*, *B*, *C* and *D*. Pulleys *7* and *8* rotate about axes *E* and *F* of slide *2* which reciprocates along fixed guides *a-a*. Flexible link *1* runs over pulleys *3*, *4*, *5*, *6*, *7* and *8*, and its ends are connected by turning pairs *E* and *F* to pulleys *7* and *8*. When any of pulleys *3*, *4*, *5* and *6* is rotated first in one direction and then in the other, slide *2* reciprocates along guides *a-a*.

3497	ROPE DRIVE MECHANISM WITH A DOUBLE SNAIL SHEAVE	SFL ML



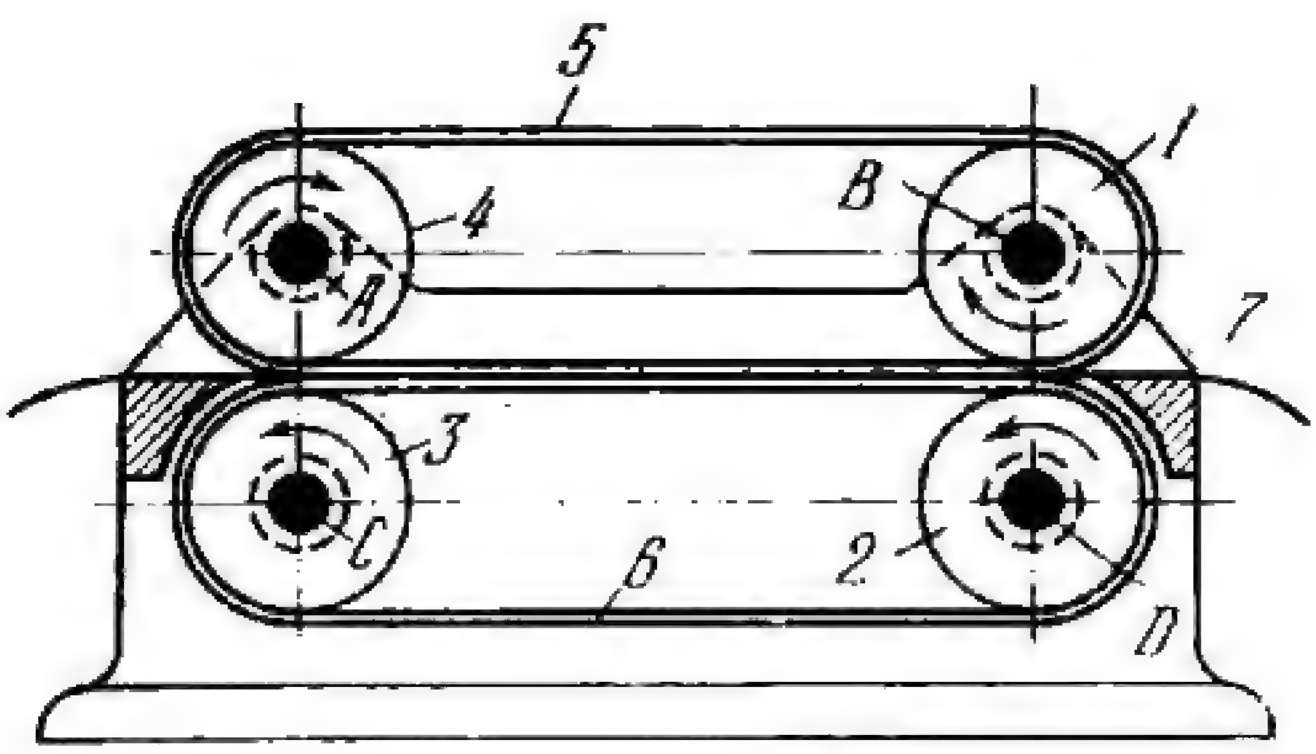
Double snail sheave *1* has a double conical spiral groove and rotates about fixed axis *D*. Sheave *1* has two ropes, *2* and *3*. From the position shown, rope *2*, secured at point *A*, is being unwound from sheave *1* and wound on drum *4* which rotates about fixed axis *E*. At the same time, rope *3*, secured at point *B* is being wound on sheave *1* and unwound from drum *5* which rotates about axis *C*. When rope *2* is on drum *4* and rope *3* on sheave *1*, the sheave and drums are reversed.

3498	**ELLIPTIC PULLEY FLEXIBLE-LINK DRIVE MECHANISM**	SFL ML



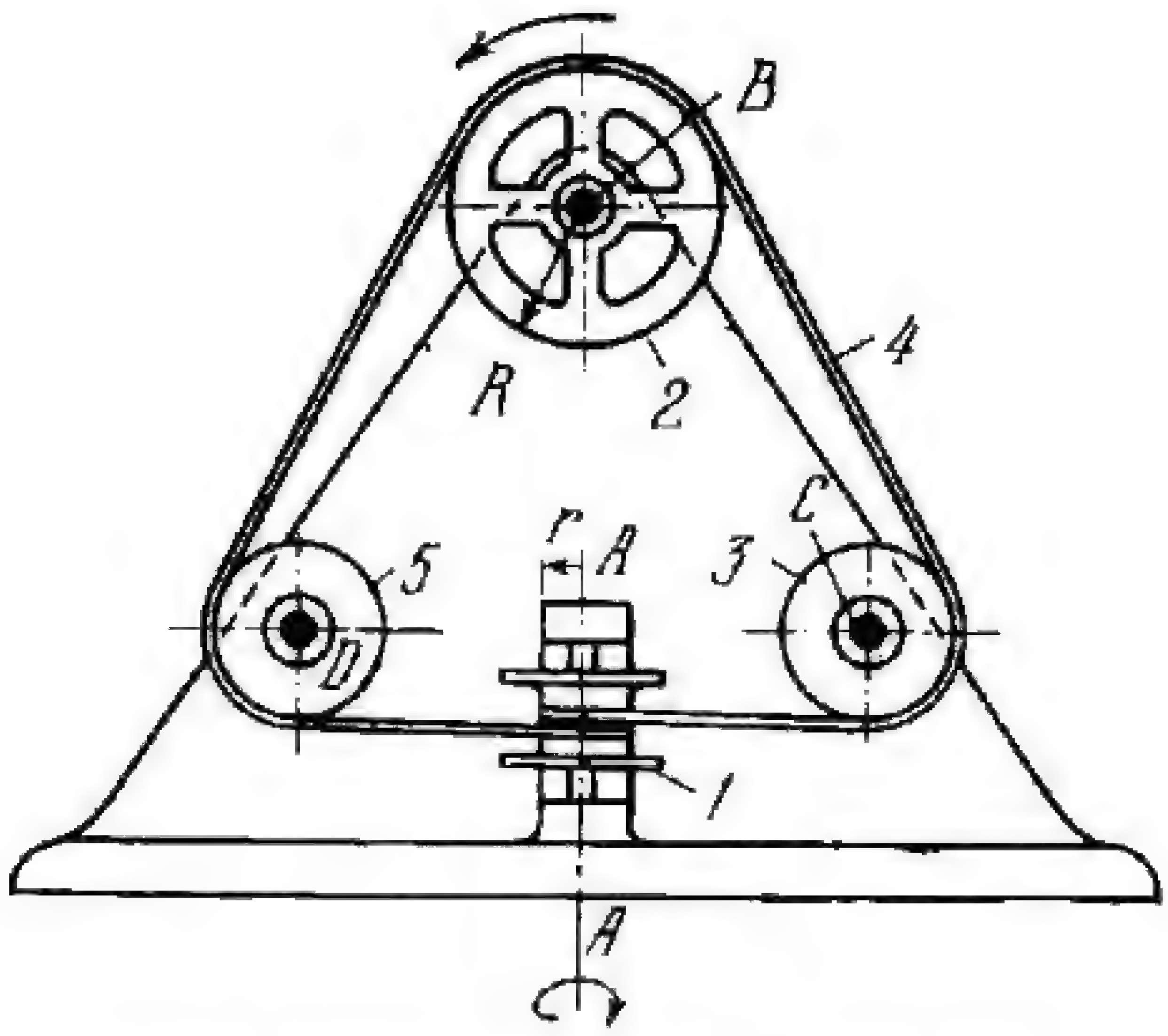
Elliptic pulley *1* rotates about fixed axis *A* which passes through the centre of ellipse *a*. Pulley *2* rotates about fixed axis *B*. Flexible link *4* runs over pulleys *1* and *2*. Idler pulley *3* rotates about axis *D* of lever *5* which turns about fixed axis *C*. Spring *6* presses pulley *3* against flexible link *4* to maintain constant tension of the link. When pulley *1* rotates at uniform speed, pulley *2* rotates at nonuniform speed.

3499	**FLEXIBLE-LINK STRIP FEED MECHANISM**	SFL ML



Four identical pulleys *1*, *2*, *3* and *4* rotate about fixed axes *B*, *D*, *C* and *A*. Flexible link *5* runs over pulleys *1* and *4*; flexible link *6* runs over pulleys *2* and *3*. When pulleys *1* and *4* rotate clockwise, and pulleys *2* and *3* counterclockwise, flexible links *5* and *6* grip strip *7* and feed it to the left.

3500	SPATIAL DRIVE MECHANISM WITH AN OPEN FLEXIBLE LINK	SFL ML

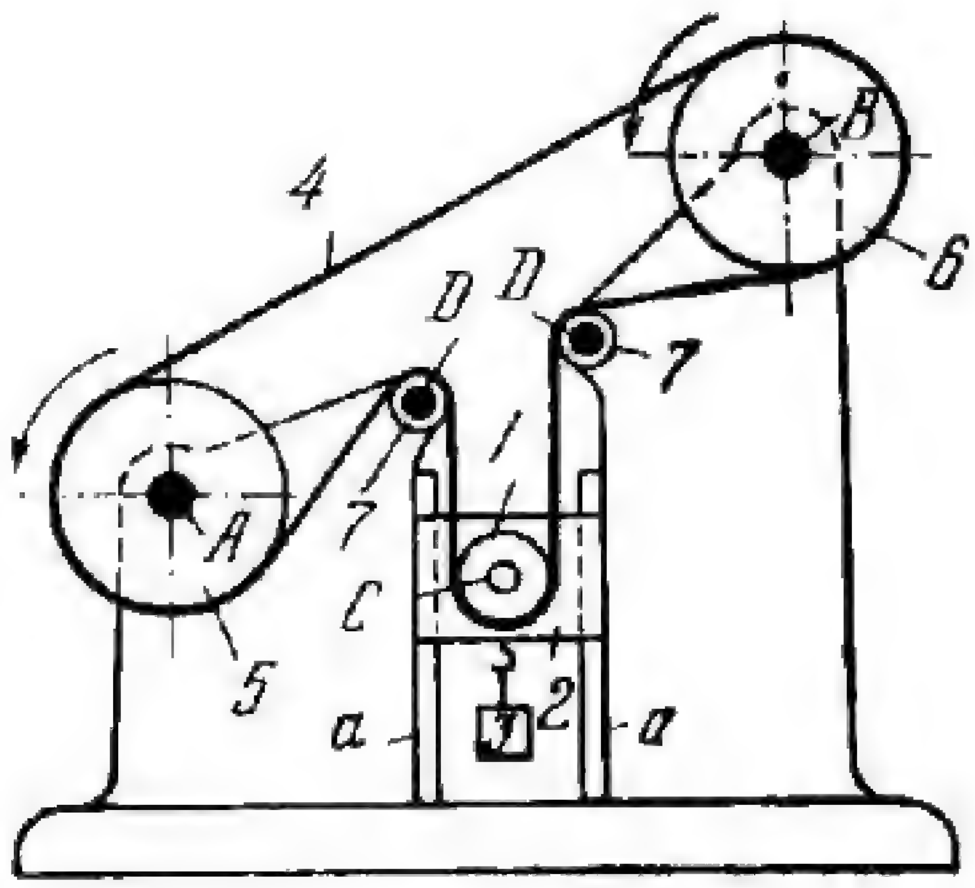


Reel *1* rotates about fixed axis *A-A*. Open flexible link *4* runs 360° around reel *1*, over pulley *2* and two identical guide rollers *3* and *5*. Pulley *2* and rollers *3* and *5* rotate about fixed axes *B*, *C* and *D*. The mechanism transmits rotation between axes *A-A* and *B* which intersect at right angles. The transmission ratio between reel *1* and pulley *2* is

$$i_{12} = \frac{\omega_1}{\omega_2} = \frac{n_1}{n_2} = \frac{R}{r}$$

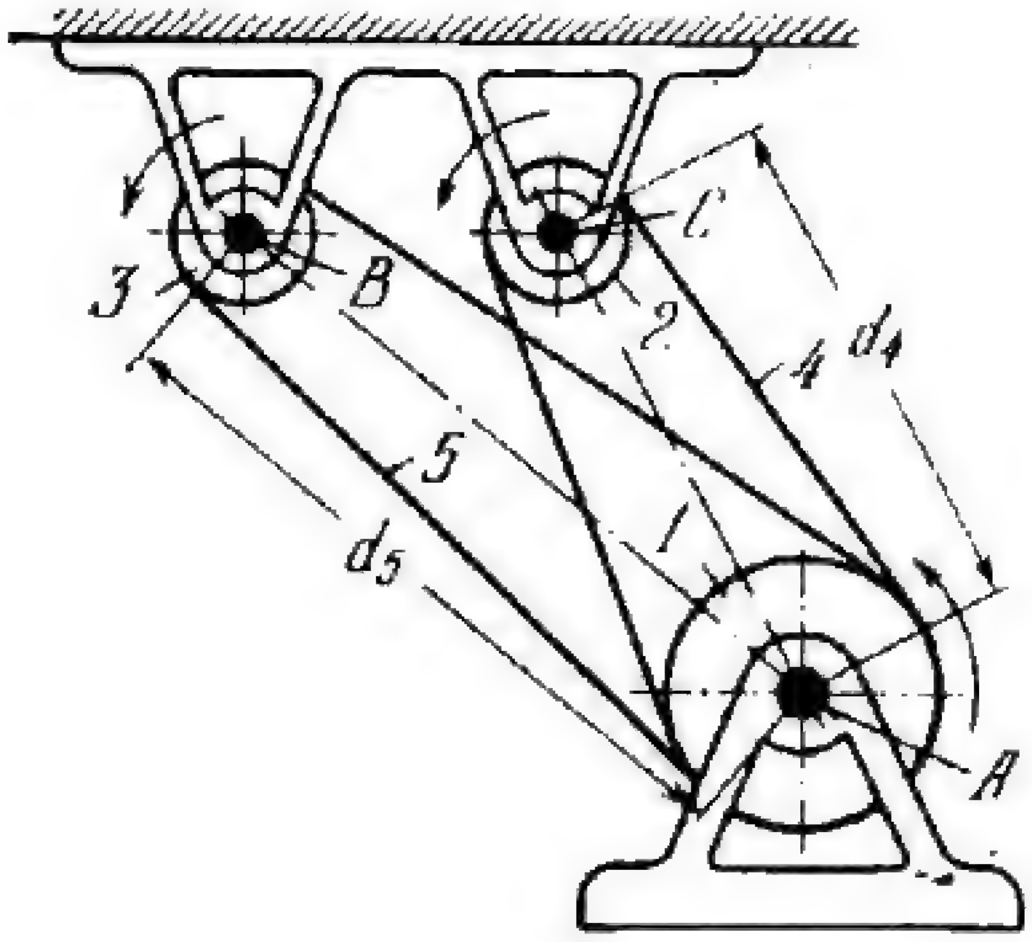
where ω_1, ω_2, n_1 and n_2 are the angular velocities and speeds (in rpm) of reel *1* and pulley *2*, R is the radius of pulley *2* and r is the radius of reel *1*.

3501	FLEXIBLE-LINK DRIVE MECHANISM WITH AN IDLER PULLEY	SFL ML



Pulleys *5* and *6* rotate about fixed axes *A* and *B*. Flexible link *4* runs over pulleys *5* and *6*, guide rollers *7*, rotating about fixed axes *D*, and idler pulley *1* which rotates about axis *C* of slider *2*. Slider *2* moves in fixed guides *a-a*. The required tension of link *4* is maintained by weight *3*.

3502	FLEXIBLE-LINK DRIVE MECHANISM FOR TWO NON-COAXIAL PULLEYS	SFL ML



Pulley *1* rotates about fixed axis *A*. Two identical pulleys *2* and *3* rotate about fixed axes *C* and *B*. Flexible link *4* runs over pulleys *1* and *2*; flexible link *5* runs over pulleys *1* and *3*. The transmission ratios from pulley *1* to pulleys *2* and *3* are

$$i_{12}=i_{13}=\frac{\omega_1}{\omega_2}=\frac{\omega_1}{\omega_3}=\frac{n_1}{n_2}=\frac{n_1}{n_3}=\frac{R_2}{R_1}=\frac{R_3}{R_1}$$

where ω_1, ω_2, ω_3, n_1, n_2 and n_3 are the angular velocities and speeds (in rpm) of pulleys *1*, *2* and *3*, and R_1, R_2 and R_3 are the radii of these pulleys. Under the condition that $R_2 = R_3 < R_1$, the lengths of flexible links *4* and *5* are

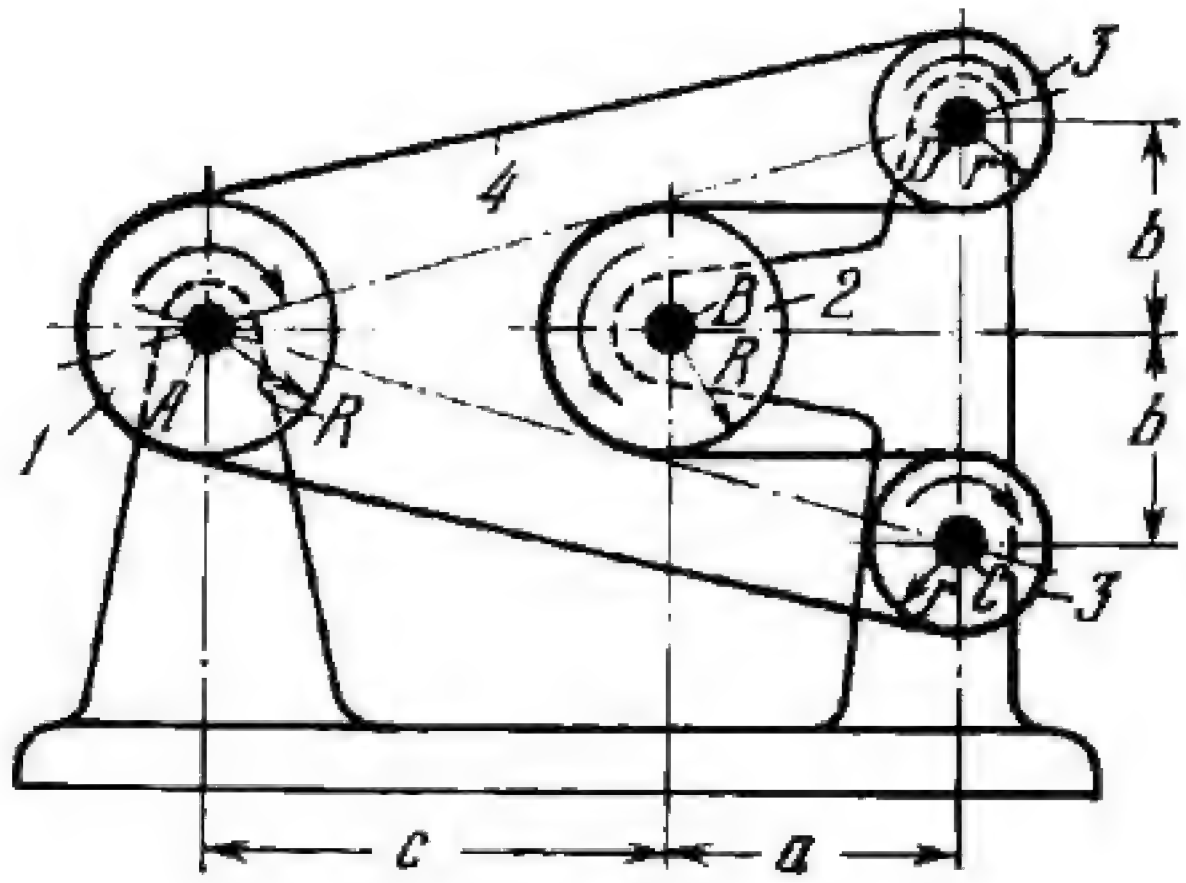
$$L_4=\pi(R_1+R_2)+2(R_1-R_2)\arcsin\frac{R_1-R_2}{d_4}+$$
$$+2\sqrt{d_4^2-(R_1-R_2)^2}$$

and

$$L_5=\pi(R_1+R_3)+2(R_1-R_3)\arcsin\frac{R_1-R_3}{d_5}+$$
$$+2\sqrt{d_5^2-(R_1-R_3)^2}$$

where d_4 and d_5 are the distances between axis *A* and axes *C* and *B*.

3503	**OPEN FLEXIBLE-LINK DRIVE MECHANISM WITH PULLEYS ROTATING IN OPPOSITE DIRECTIONS**	SFL ML



Pulleys *1* and *2* of radius R rotate about fixed axes A and B. Pulleys *3* of radius r rotate about fixed axes C and D. Flexible link *4* runs over pulleys *1*, *2* and *3*. The transmission ratio from pulley *1* to pulley *2* is

$$i_{12}=\frac{\omega_1}{\omega_2}=-\frac{n_1}{n_2}=-1$$

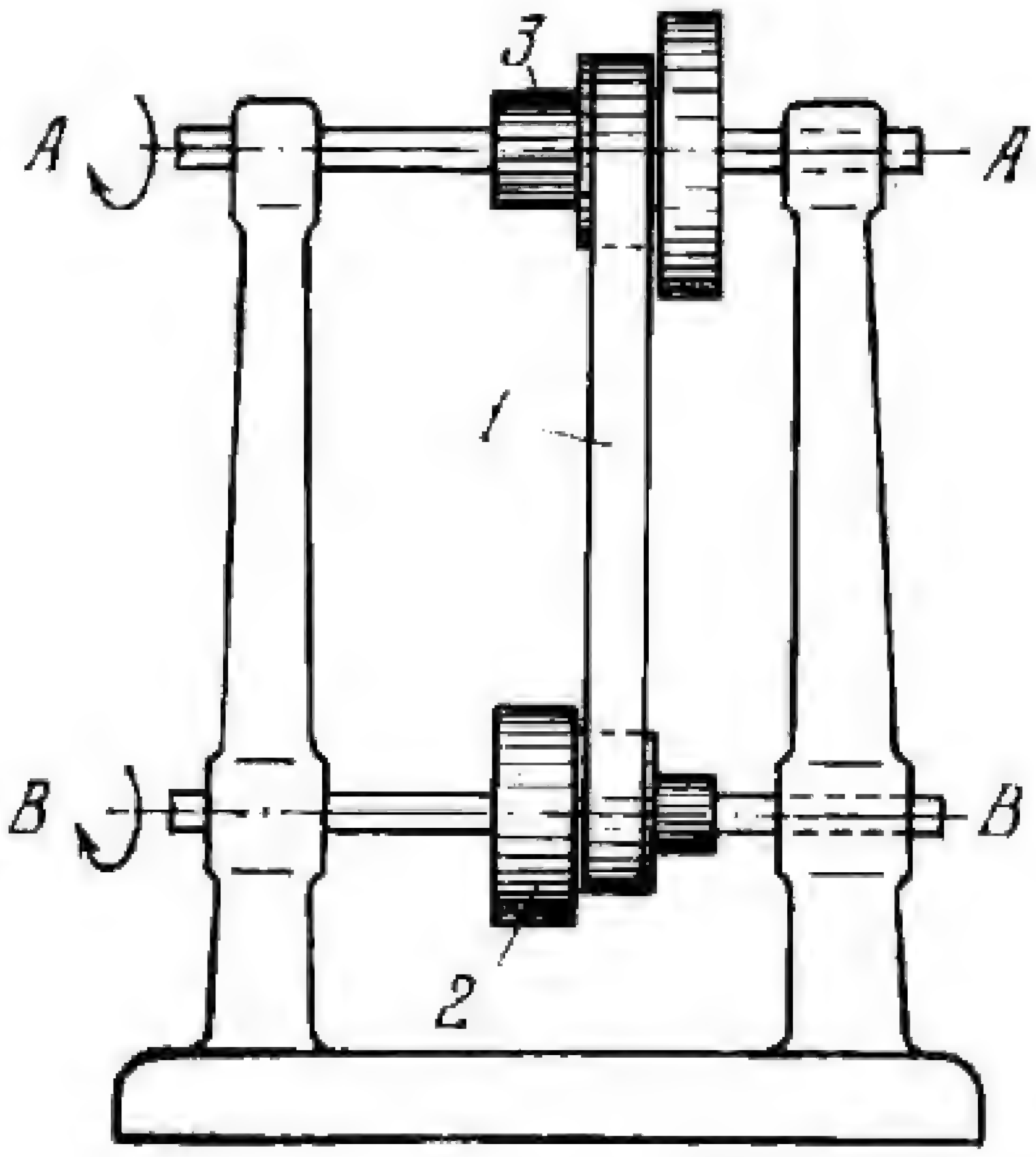
where ω_1, ω_2, n_1 and n_2 are the angular velocities and speeds (in rpm) of pulleys *1* and *2*. Thus pulleys *1* and *2* rotate in opposite directions. The length of link *4* is

$$L=2\pi(R+r)+2\left[(R-r)\arcsin\frac{R-r}{d}+\sqrt{d^2-(R-r)^2}+a\right]$$

where d is the distance from axis A to axis C or D and equals

$$d=\sqrt{(a+c)^2+b^2}.$$

3504	CONE-PULLEY OPEN BELT DRIVE MECHANISM	SFL BD

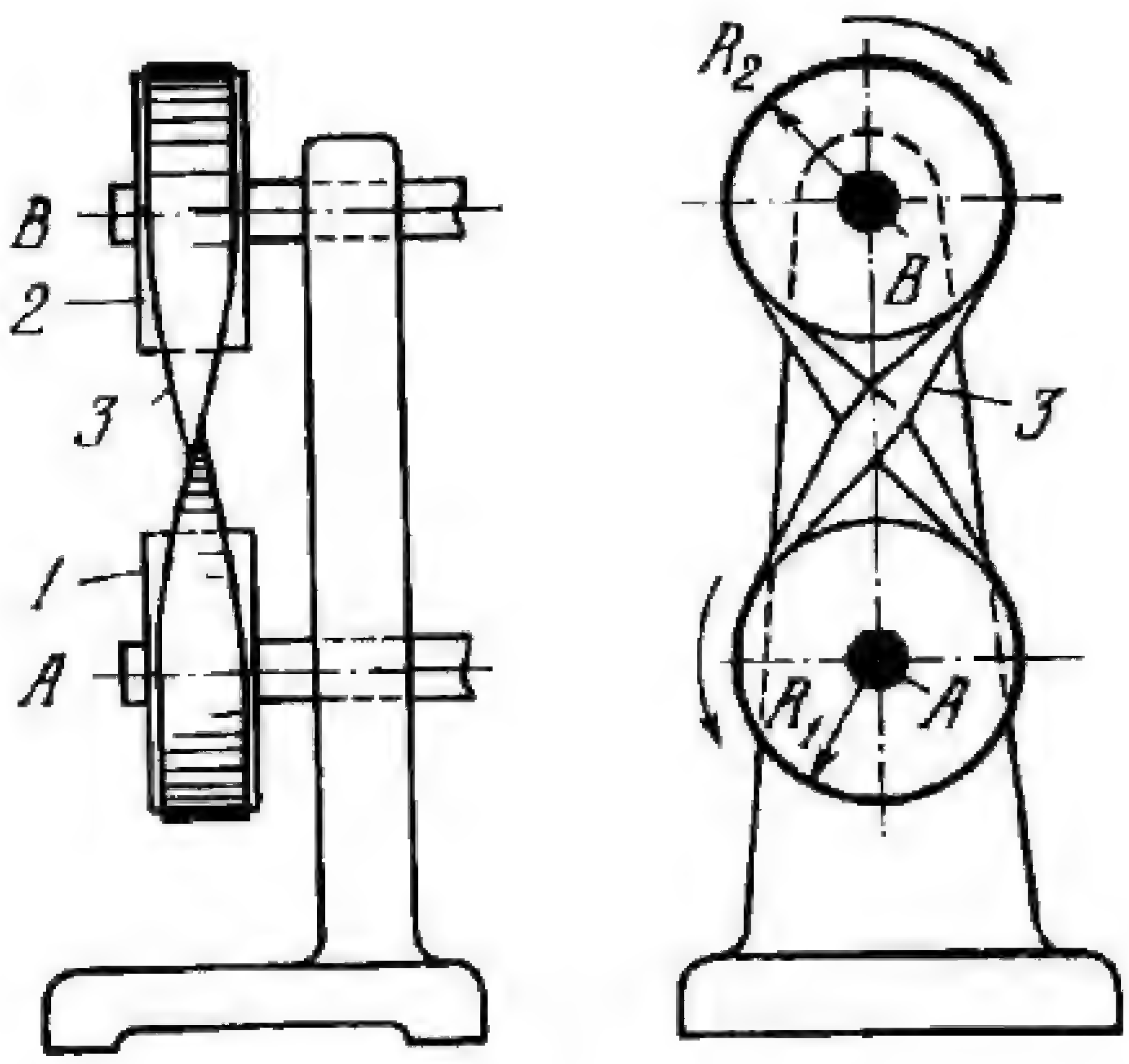


Three-step cone pulleys *2* and *3* rotate about fixed axes *B-B* and *A-A*. Open belt *1* runs over opposing steps of pulleys *2* and *3*. By shifting the belt from one pair of steps to another, three different transmission ratios are obtained. The radii of the steps are selected from the condition of a constant length L of the belt. This condition need not be complied with if an idler pulley is used. The transmission ratio from pulley *2* to pulley *3* is

$$i_{23} = \frac{\omega_2}{\omega_3} = \frac{n_2}{n_3} = \frac{R_3}{R_2}$$

where ω_2, ω_3, n_2 and n_3 are the angular velocities and speeds (in rpm) of pulleys *2* and *3*, and R_2 and R_3 are the radii of the corresponding opposing steps of pulleys *2* and *3*.

3505	CROSSED BELT DRIVE MECHANISM	SFL BD

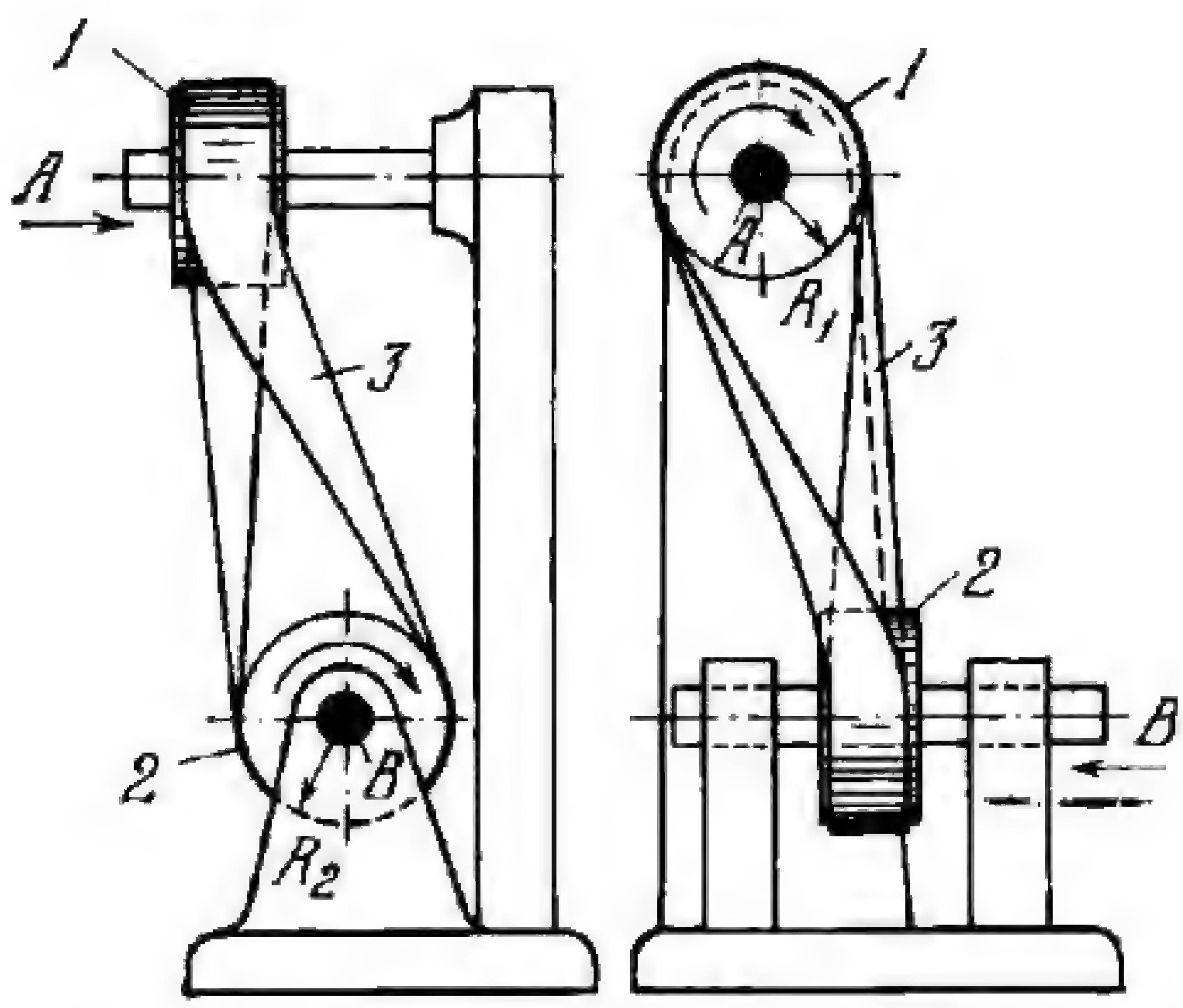


Pulleys *1* and *2* rotate about fixed axes *A* and *B*. Crossed belt *3* runs over pulleys *1* and *2*, contacting the pulleys with both of its sides. The transmission ratio from pulley *1* to pulley *2* is

$$i_{12} = \frac{\omega_1}{\omega_2} = -\frac{n_1}{n_2} = -\frac{R_2}{R_1}$$

where ω_1, ω_2, n_1 and n_2 are the angular velocities and speeds (in rpm) of pulleys *1* and *2*, and R_1 and R_2 are the radii of pulleys *1* and *2*.

3506	QUARTER-TURN BELT DRIVE MECHANISM	SFL BD

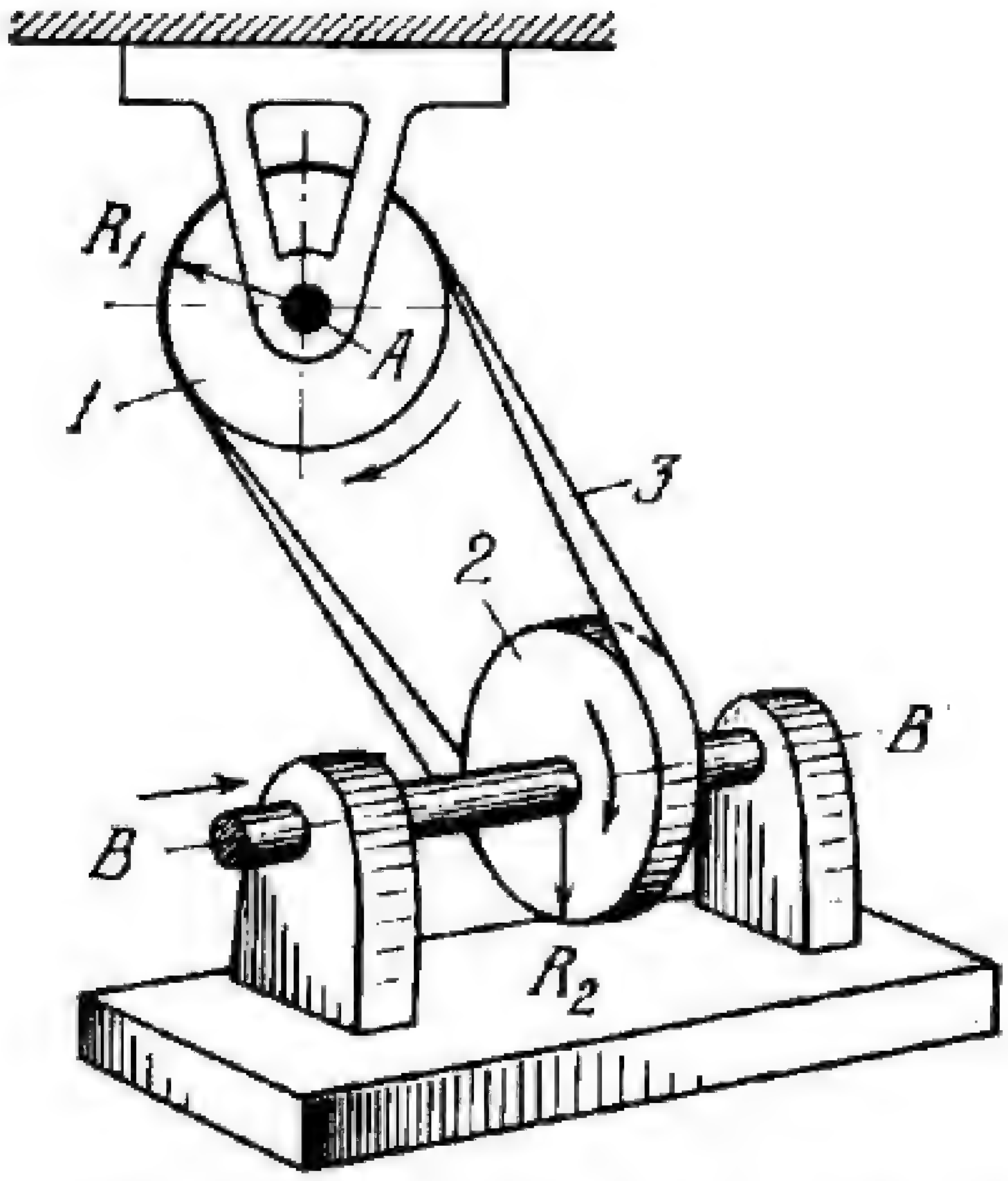


Pulleys *1* and *2* rotate about fixed axes *A* and *B* which cross at right angles. Quarter-turn belt *3* runs over pulleys *1* and *2*, contacting the pulleys with one of its sides. The transmission ratio from pulley *1* to pulley *2* is

$$i_{12} = \frac{\omega_1}{\omega_2} = \frac{n_1}{n_2} = \frac{R_2}{R_1}$$

where ω_1, ω_2, n_1 and n_2 are the angular velocities and speeds (in rpm) of pulleys *1* and *2*, and R_1 and R_2 are the radii of pulleys *1* and *2*. Looking along axes *A* and *B* in the direction of the arrows, pulleys *1* and *2* both rotate clockwise.

3507	CROSSED-AXES OPEN BELT DRIVE MECHANISM	SFL BD

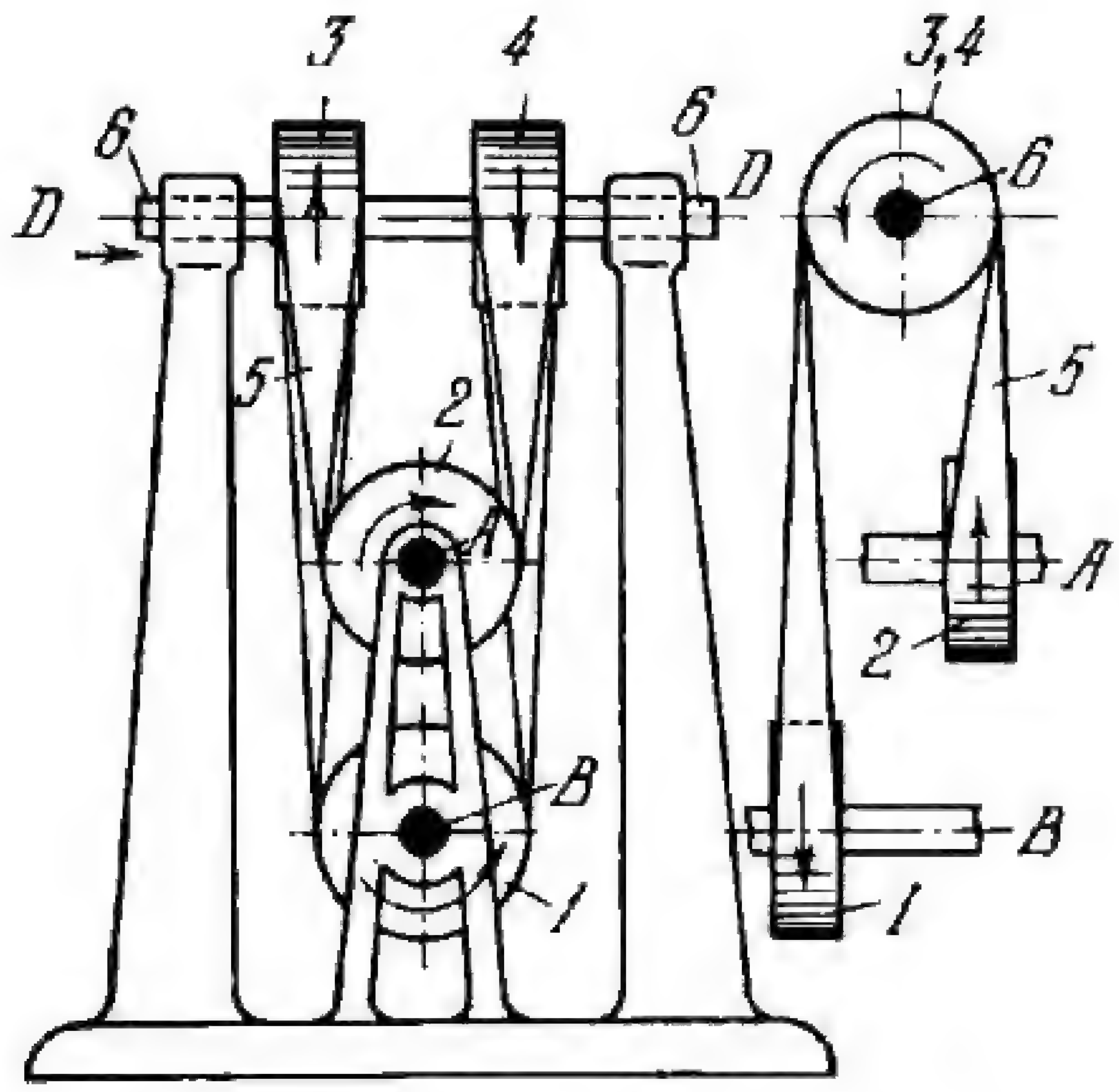


Pulleys *1* and *2* rotate about fixed axes *A* and *B-B* which cross at a certain angle. Half-crossed belt *3* runs over pulleys *1* and *2*, contacting the pulleys with one of its sides. The transmission ratio from pulley *1* to pulley *2* is

$$i_{12} = \frac{\omega_1}{\omega_2} = \frac{n_1}{n_2} = \frac{R_2}{R_1}$$

where ω_1, ω_2, n_1 and n_2 are the angular velocities and speeds (in rpm) of pulleys *1* and *2*, and R_1 and R_2 are the radii of pulleys *1* and *2*. Looking along axis *B-B* in the direction of the arrow, pulleys *1* and *2* both rotate clockwise.

3508	REVERSIBLE QUARTER-TURN BELT DRIVE MECHANISM WITH TWO PARALLEL AND TWO COAXIAL PULLEYS	SFL BD

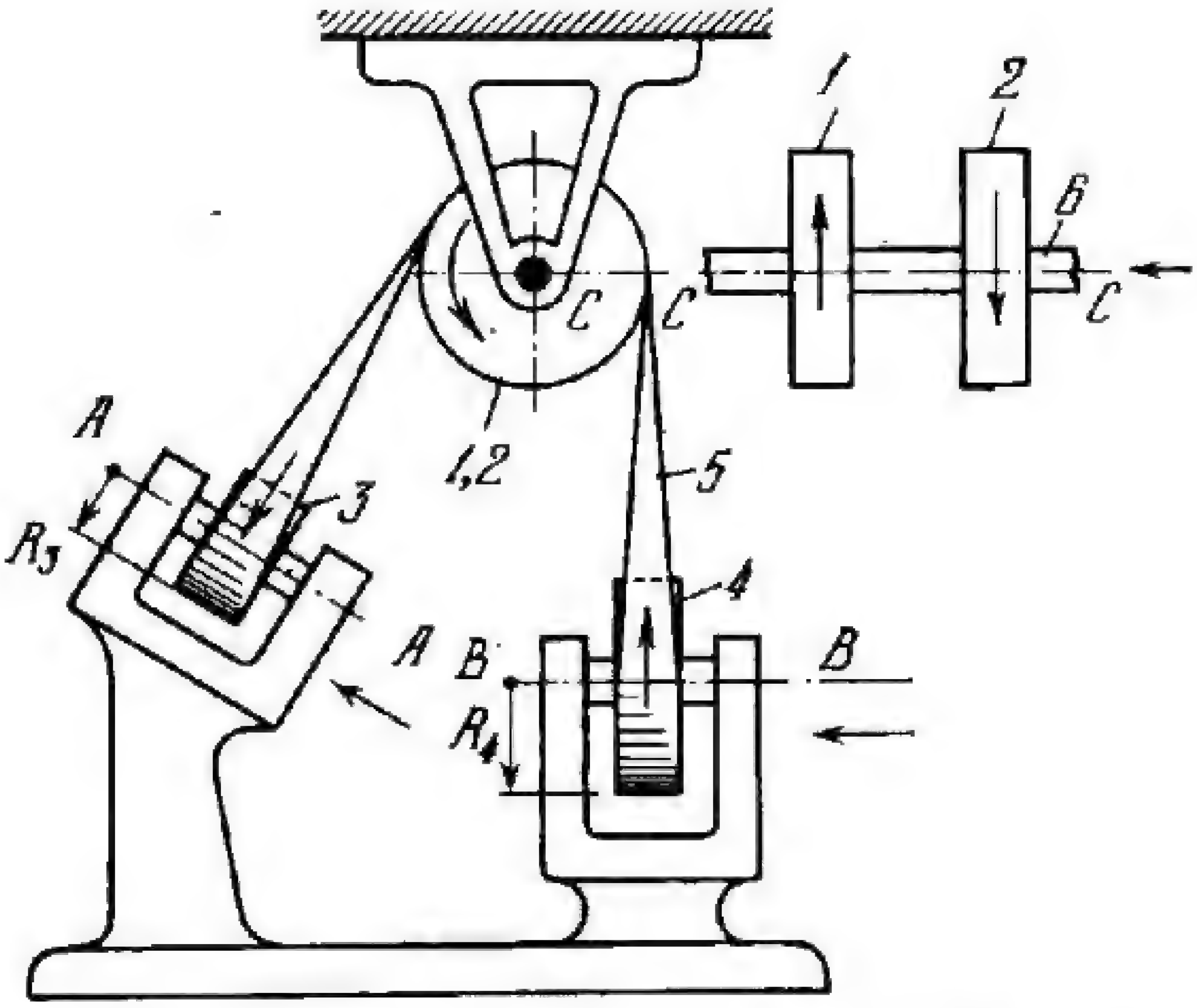


Two identical pulleys *3* and *4* rotate freely on fixed axle *6* about fixed axis *D-D*. Belt *5* runs over pulleys *3* and *4*, contacting the pulleys with both of its sides, and over identical guide pulleys *1* and *2* which rotate about parallel fixed axes *B* and *A*. The transmission ratio from pulley *1* to pulley *2* is

$$i_{12} = -1.$$

Looking along axis *D-D* in the direction of the arrow, pulleys *3* and *4* rotate at the same speed but in opposite directions.

3509	BELT DRIVE MECHANISM WITH COAXIAL GUIDE PULLEYS	SFL BD

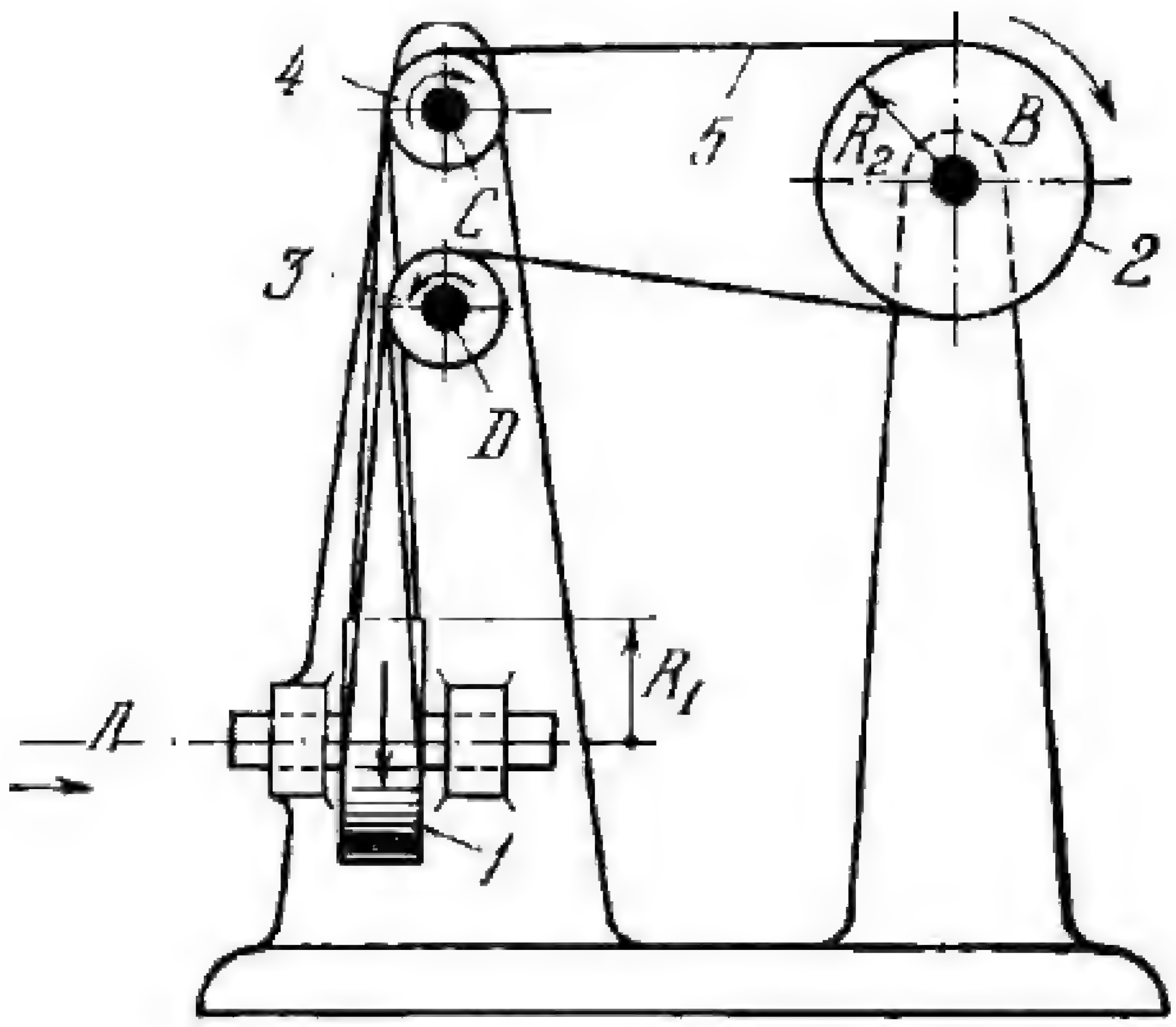


Pulleys *3* and *4* rotate about fixed axes *A-A* and *B-B* which intersect at an arbitrary angle. Guide pulleys *1* and *2* rotate freely on fixed axle *6* about common fixed axis *C-C*. Belt *5* runs over pulleys *3*, *4*, *1* and *2*, contacting the pulleys with both of its sides. The transmission ratio from pulley *3* to pulley *4* is

$$i_{34} = \frac{\omega_3}{\omega_4} = -\frac{n_3}{n_4} = -\frac{R_4}{R_3}$$

where ω_3, ω_4, n_3 and n_4 are the angular velocities and speeds (in rpm) of pulleys *3* and *4*, and R_3 and R_4 are the radii of pulleys *3* and *4*. Looking along axes *A-A*, *B-B* and *C-C* in the direction of the arrows, pulleys *1* and *2*, and pulleys *3* and *4* rotate in opposite directions.

3510	BELT DRIVE MECHANISM WITH PARALLEL-AXIS GUIDE PULLEYS	SFL BD

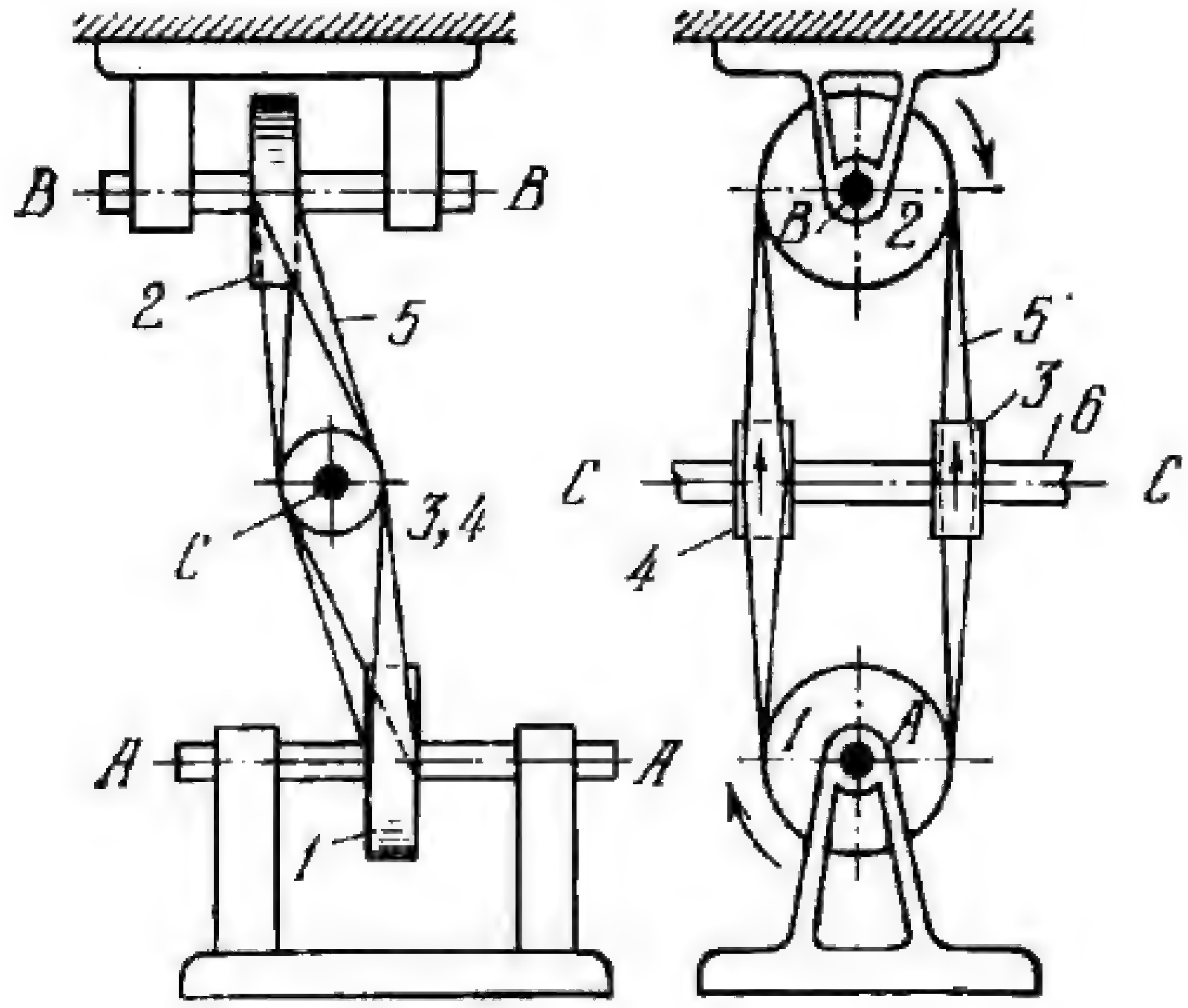


Pulleys *1* and *2* rotate about fixed axes A and B which cross at right angles. Belt *5* runs over pulleys *1* and *2*, contacting the pulleys with both of its sides, and over two identical guide pulleys *3* and *4* which rotate about parallel fixed axes D and C. The transmission ratio from pulley *1* to pulley *2* is

$$i_{12}=\frac{\omega_1}{\omega_2}=\frac{n_1}{n_2}=\frac{R_2}{R_1}$$

where ω_1, ω_2, n_1 and n_2 are the angular velocities and speeds (in rpm) of pulleys *1* and *2*, and R_1 and R_2 are the radii of pulleys *1* and *2*. Looking along axis A in the direction of the arrow, pulleys *1* and *2* both rotate clockwise.

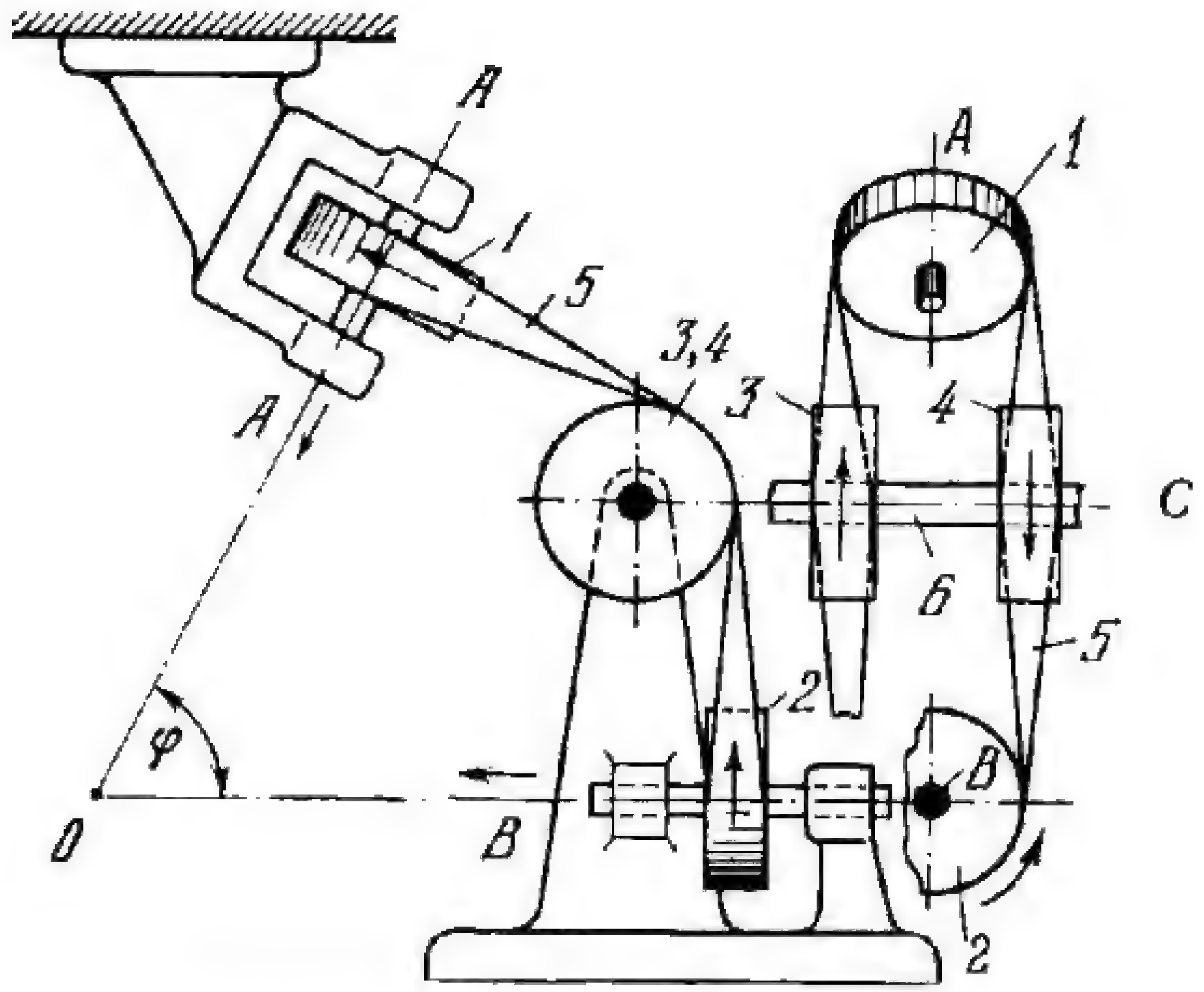
3511	DOUBLE QUARTER-TURN BELT DRIVE MECHANISM WITH TWO PARALLEL AND TWO COAXIAL PULLEYS	SFL BD



Identical pulleys *1* and *2* rotate about parallel fixed axes *A-A* and *B-B*. Belt *5* runs over pulleys *1* and *2*, and over identical pulleys *3* and *4* which rotate freely on fixed axle *6* about fixed axis *C-C*. The transmission ratio from pulley *1* to pulley *2* is

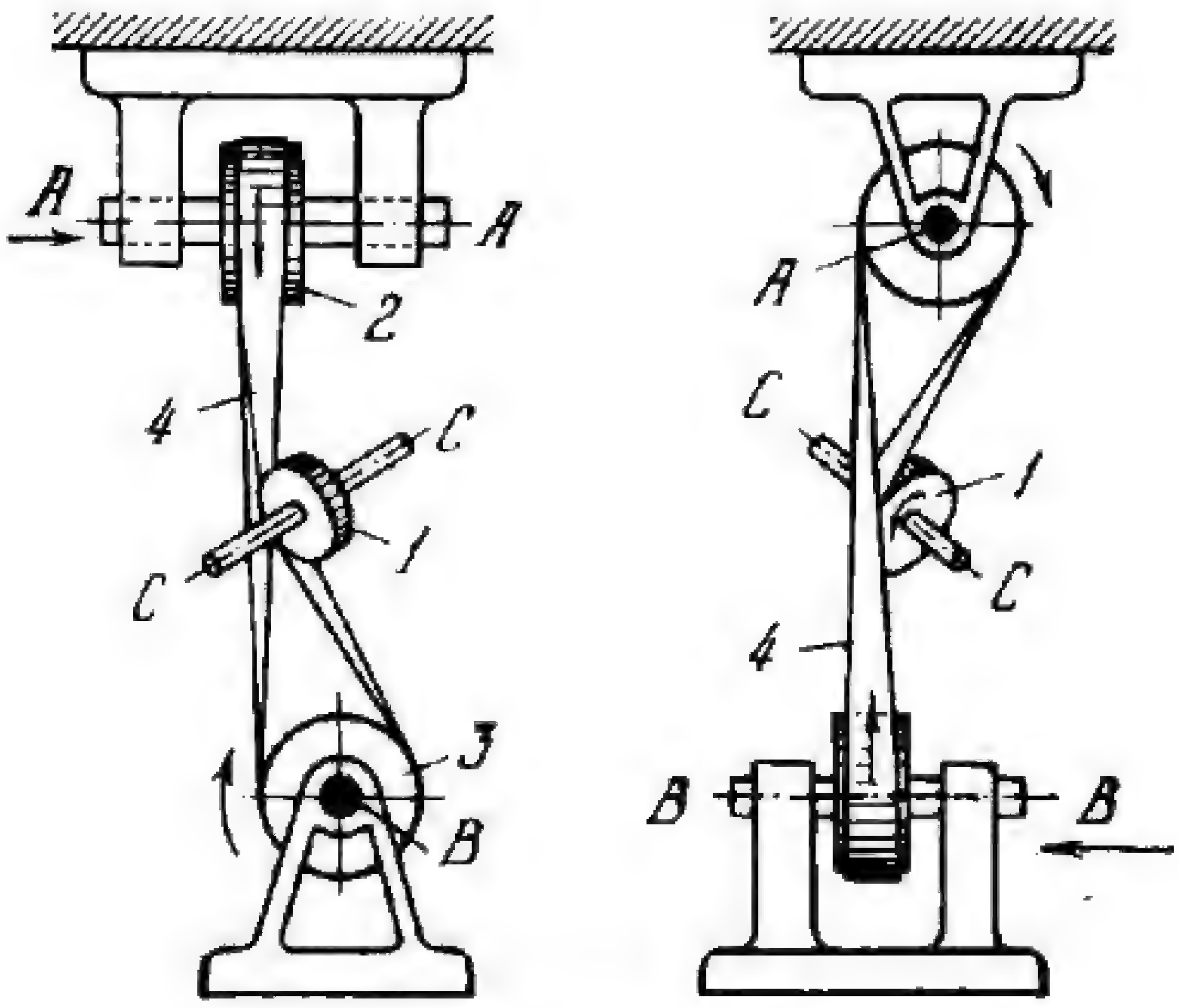
$$i_{12} = 1.$$

3512	BELT DRIVE MECHANISM FOR INTERSECTING AXES	SFL BD



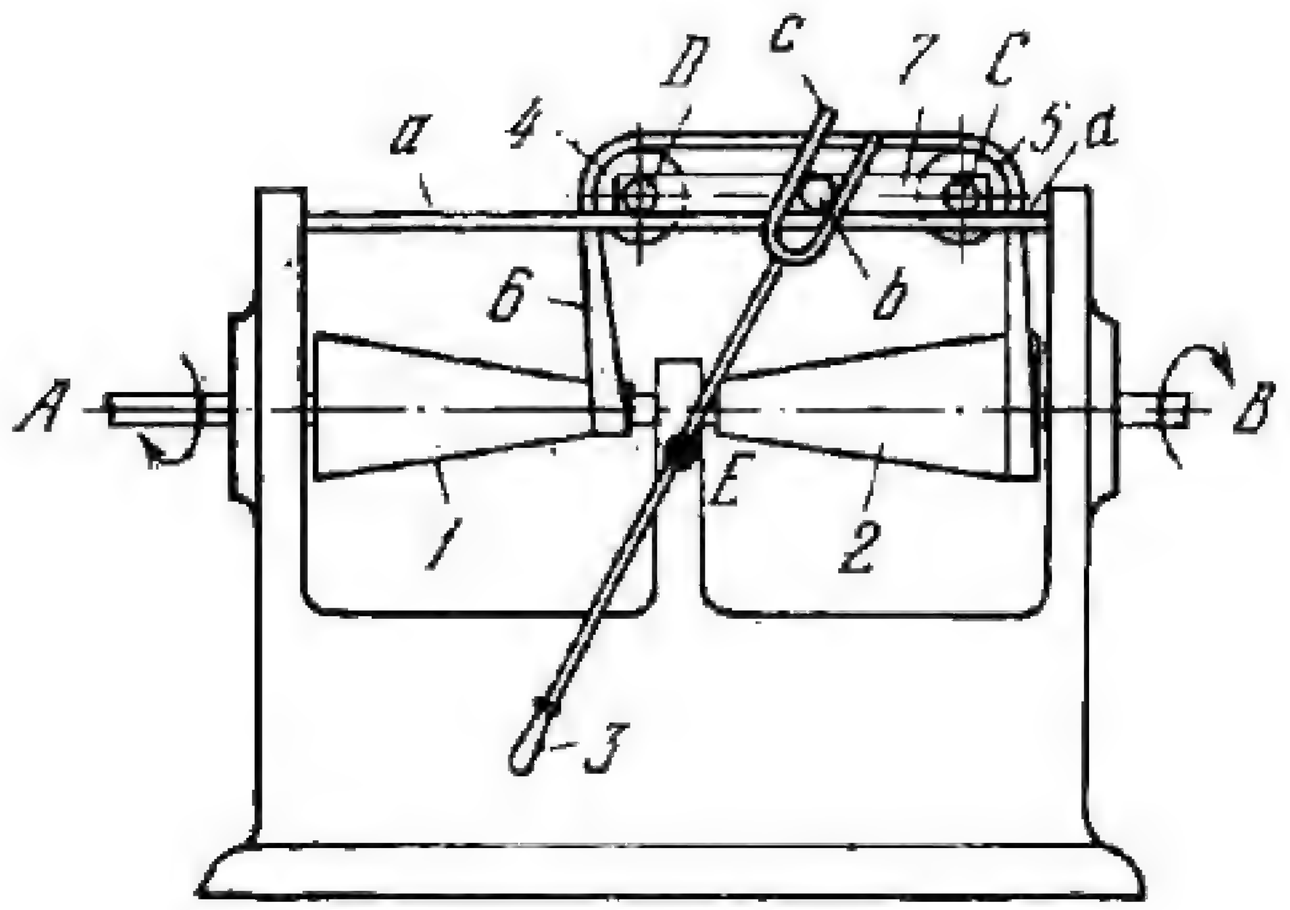
Two identical pulleys *1* and *2* rotate about fixed axes *A-A* and *B-B* which intersect at point *O* at angle φ. Belt *5* runs over pulleys *1* and *2*, and over guide pulleys *3* and *4* which rotate freely on fixed axle *6* about fixed axis *C*. The transmission ratio from pulley *1* to pulley *2* is $i_{12} = 1$, i.e. the pulleys rotate at equal speeds and, looking along axes *A-A* and *B-B* in the directions of the arrows, they both rotate clockwise. Pulleys *3* and *4* rotate in opposite directions.

3513	**REVERSIBLE QUARTER-TURN BELT DRIVE MECHANISM WITH AN IDLER PULLEY**	SFL BD



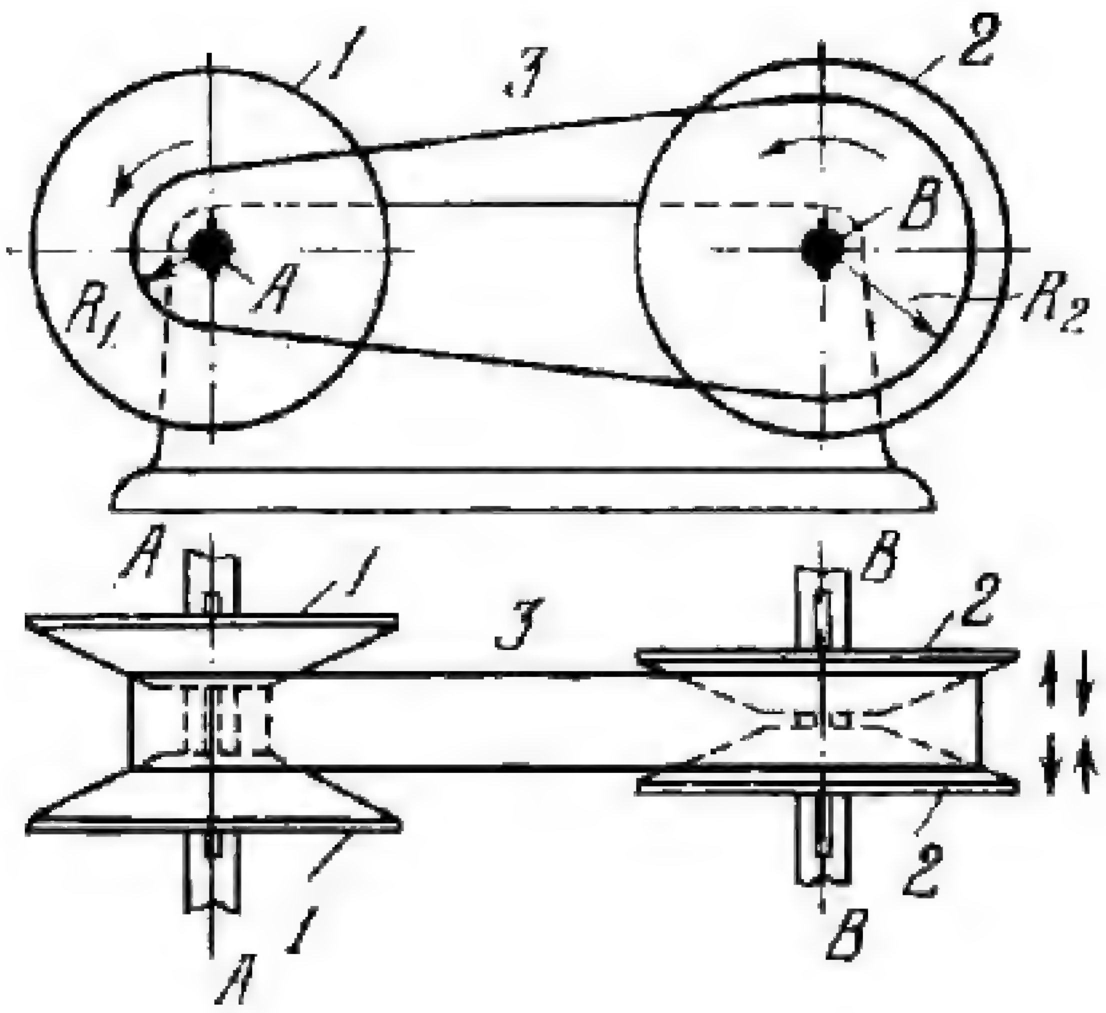
Two identical pulleys *2* and *3* rotate about fixed axes *A-A* and *B-B* which cross at right angles. Quarter-turn belt *4* runs over pulleys *2* and *3*, contacting the pulleys with one side. Idler pulley *1*, rotating about fixed axis *C-C*, both tensions and guides the belt. The transmission ratio from pulley *2* to pulley *3* is $i_{23} = 1$, i.e. the pulleys rotate at equal speeds and, looking along axes *A-A* and *B-B* in the directions of the arrows, they both rotate clockwise.

3514	COAXIAL INFINITELY VARIABLE BELT DRIVE MECHANISM	SFL BD



Two identical conical pulleys *1* and *2* rotate about fixed axes *A* and *B*. Belt *6* runs over pulleys *1* and *2*, and over two pairs of identical guide rollers *4* and *5* rotating about axes *D* and *C* of carriage *7* which can slide along fixed guides *a-a*. The belt is shifted by fork *c*, engaging pin *b* of carriage *7*, when lever *3* is turned about fixed axis *E*. The transmission ratio between pulleys *1* and *2* depends upon the position of belt *6* on pulleys *1* and *2*. These pulleys rotate in opposite directions.

3515	VARIABLE-SPEED V-BELT DRIVE MECHANISM	SFL BD

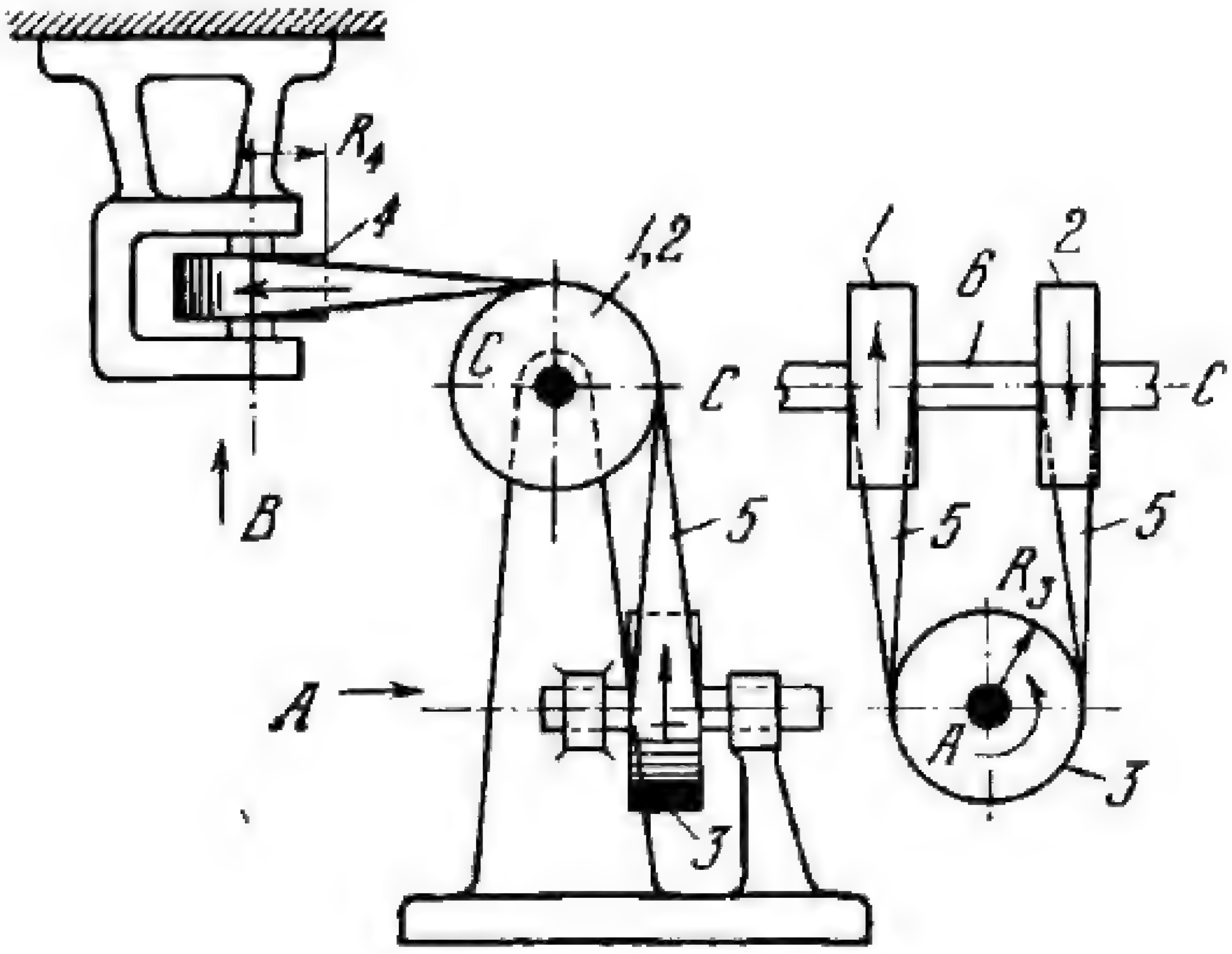


Two identical conical disks *1* form an adjustable sheave that rotates about fixed axis A-A and whose side members (disks) *1* can be brought closer together or spread farther apart along axis A-A. Similar conical disks *2* rotate about and slide along fixed axis B-B. Flexible link *3*, in the form of a wide V-belt, flexible but rigid to some extent laterally, runs over the sheaves with movable side disks *1* and *2*. The transmission ratio between the sheaves is variable and depends on the positions of the side disks, causing the belt to climb to a larger radius on one sheave and to move to a smaller radius on the other. In each position

$$i_{12}=\frac{\omega_1}{\omega_2}=\frac{n_1}{n_2}=\frac{R_2}{R_1}$$

where ω_1, ω_2, n_1 and n_2 are the angular velocities and speeds (in rpm) of sheaves *1* and *2*, and R_1 and R_2 are the variable radii of the circles of contact of the V-belt with the sheaves. Thus, the mechanism provides an infinitely variable transmission ratio.

3516	BELT DRIVE MECHANISM WITH COAXIAL GUIDE PULLEYS	SFL BD

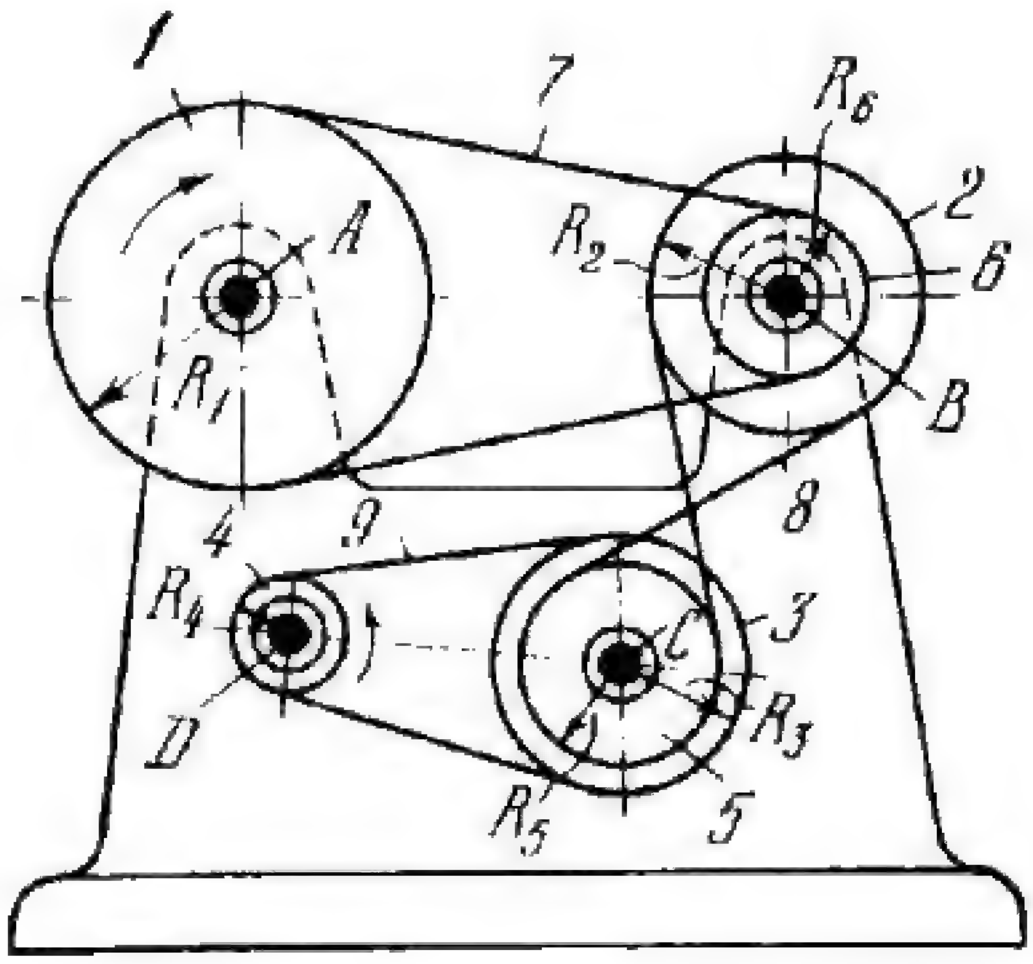


Pulleys *3* and *4* rotate about fixed axes *A* and *B* which intersect at right angles. Quarter-turn belt *5* runs over pulleys *3* and *4*, contacting the pulleys with one of its sides, and over identical coaxial guide pulleys *1* and *2* which rotate freely on fixed axle *6* about fixed axis *C-C*. The transmission ratio from pulley *3* to pulley *4* is

$$i_{34} = \frac{\omega_3}{\omega_4} = \frac{n_3}{n_4} = \frac{R_4}{R_3}$$

where ω_3, ω_4, n_3 and n_4 are the angular velocities and speeds (in rpm) of pulleys *3* and *4*, and R_3 and R_4 are the radii of pulleys *3* and *4*. Looking along axes *A* and *B* in the directions of the arrows, pulleys *3* and *4* rotate in the same direction.

3517	COMPLEX BELT DRIVE MECHANISM	SFL BD



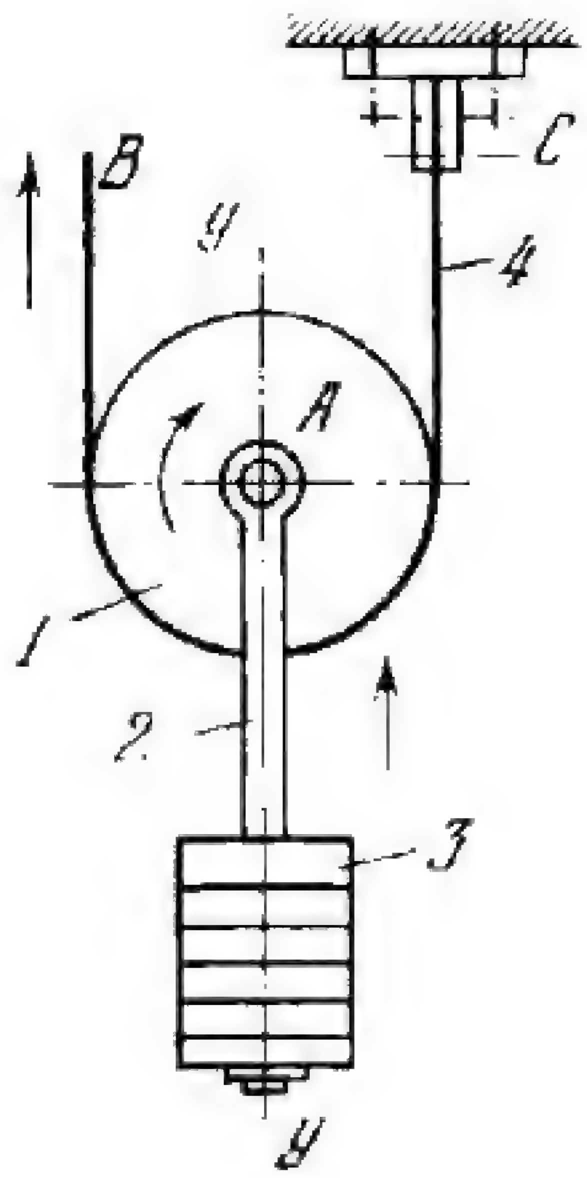
Pulleys *1*, *2*, *3* and *4* rotate about fixed axes A, B, C and D. Pulley *6* is rigidly attached to (or integral with) pulley *2*, and pulley *5* to pulley *3*. Open belt *7* runs over pulleys *1* and *6*, and open belt *9* over pulleys *3* and *4*. Crossed belt *8* runs over pulleys *2* and *5*. The total transmission ratio from pulley *1* to pulley *4* is

$$i_{14} = -\frac{R_6 R_5 R_4}{R_1 R_2 R_3}$$

where R_1, R_2, R_3, R_4, R_5 and R_6 are the radii of pulleys *1*, *2*, *3*, *4*, *5* and *6*. Pulleys *1* and *4* rotate in opposite directions.

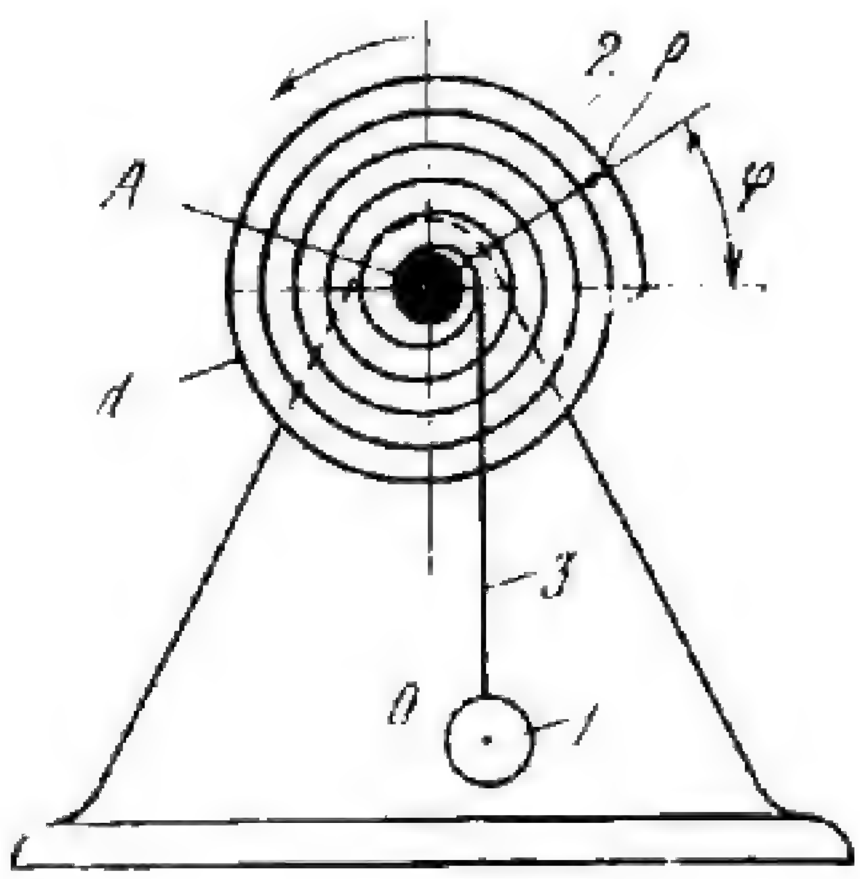
4. MECHANISMS OF MATERIALS HANDLING EQUIPMENT (3518 through 3521)

3518 SINGLE BLOCK-AND-TACKLE HOISTING MECHANISM — SFL MH



Pulley *1* rotates about axis *A* of link *2* which carries load *3*. Flexible link (rope) *4*, attached at point *C*, runs over pulley *1*. In lifting load *3*, point *B* is moved parallel to axis *y-y*. The displacement of point *B* is $s_B = 2s_A$, where s_A is the displacement of point *A*. Consequently, the block and tackle has a mechanical advantage of 2.

3519 SPIRAL-PULLEY FLEXIBLE-LINK HOISTING MECHANISM — SFL MH

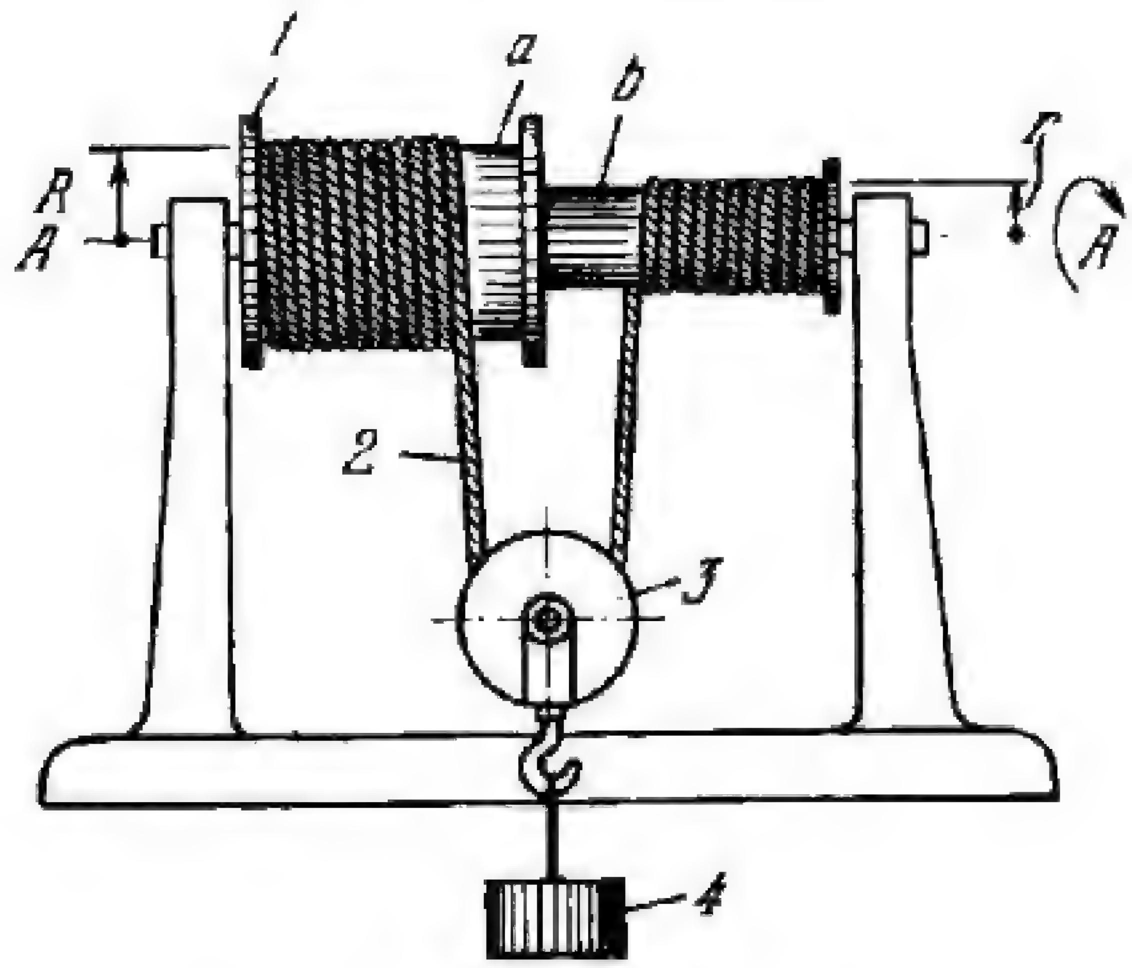


The working surface of pulley *2* is along an Archimedean spiral with the equation $\rho = a\varphi$, where a is the constant factor of the spiral. Pulley *2* rotates about fixed axis *A*. Load *1* is suspended on one end of flexible link (rope) *3* whose other end is attached to pulley *2*. When pulley *2* rotates counterclockwise, link *3* is wound on the pulley and hoists load *1*. The velocity of the centre of gravity *O* of load *1* is

$$v = \omega \sqrt{a^2 + \rho^2}$$

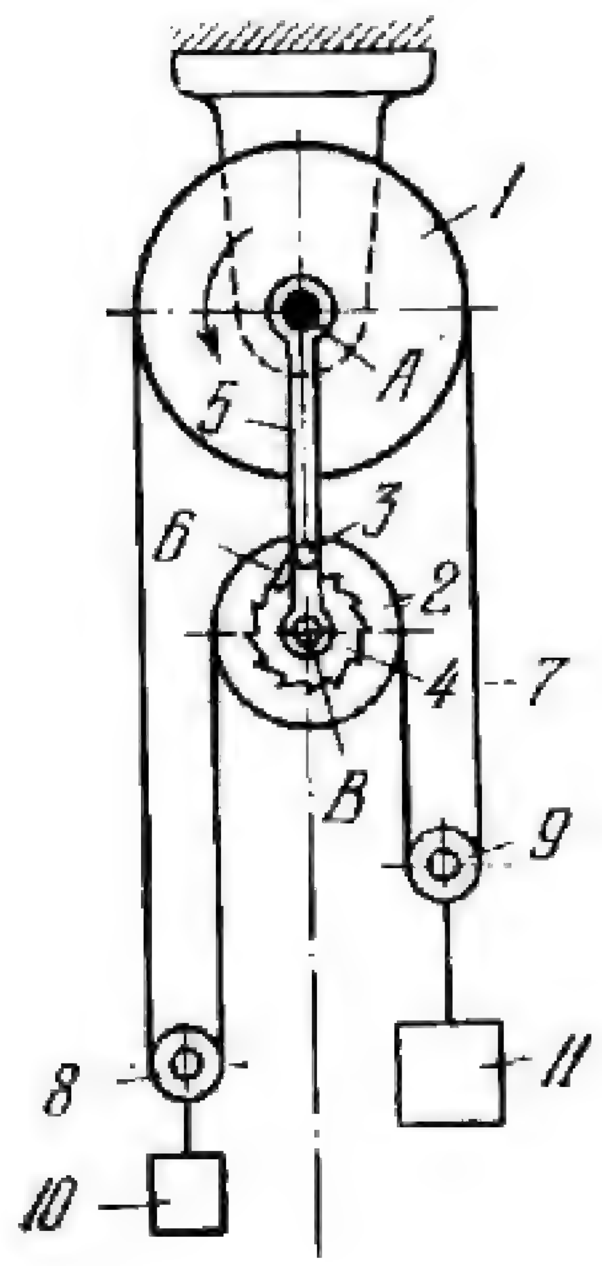
where ω is the angular velocity of pulley *2*.

3520	DIFFERENTIAL WINCH MECHANISM	SFL MH



Winch *1* consists of two drums *a* and *b* of radii R and r, and rotates about fixed axis A-A. When the winch is rotated clockwise, looking from the right, flexible link (rope) *2* is wound on drum *a* and unwound from drum *b*. At this, load *4*, suspended from pulley *3*, around which link *2* runs, is hoisted an amount h per revolution of the winch, equal to $h = \pi (R - r)$.

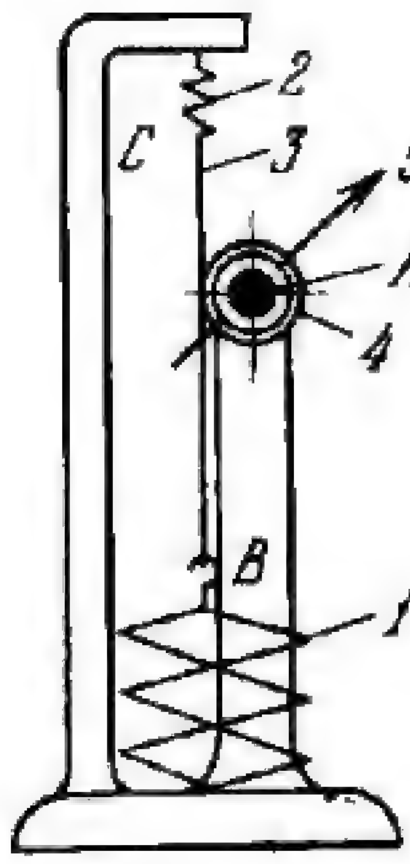
3521	RATCHET-TYPE BLOCK-AND-TACKLE HOISTING MECHANISM	SFL MH



Pulley *1* rotates about fixed axis A. Pulley *2*, rigidly attached to ratched wheel *4*, rotates about axis B of link *5* which turns freely about axis A. Link *5* carries pivoted pawl *6* which engages the teeth of ratchet wheel *4*. Flexible link (rope) *7* runs over pulleys *1* and *2*, and over freely suspended rollers *8* and *9* which carry loads *10* and *11*. Load *11* is hoisted by turning pulley *1* counterclockwise. The ratchet device prevents clockwise rotation of pulley *2* while load *11* is being hoisted. Load *10* serves to tension flexible link *7*.

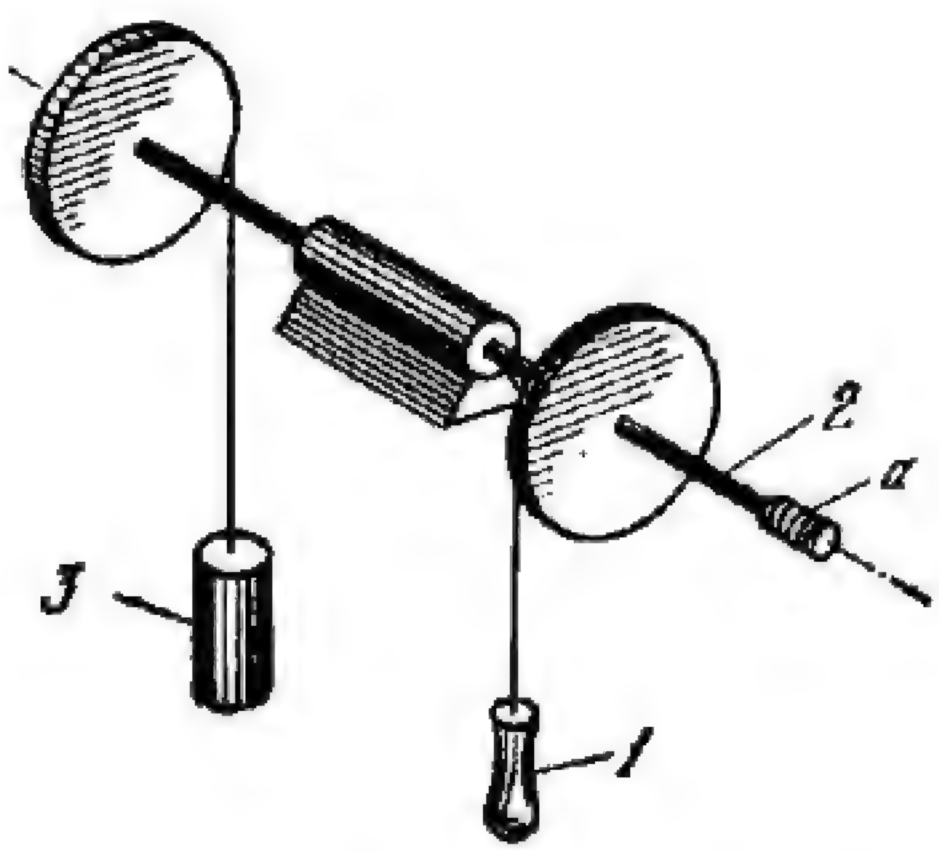
5. MECHANISMS OF MEASURING AND TESTING DEVICES (3522 through 3526)

3522	FLEXIBLE-LINK MECHANISM OF AN ANEROID BAROMETER	SFL M



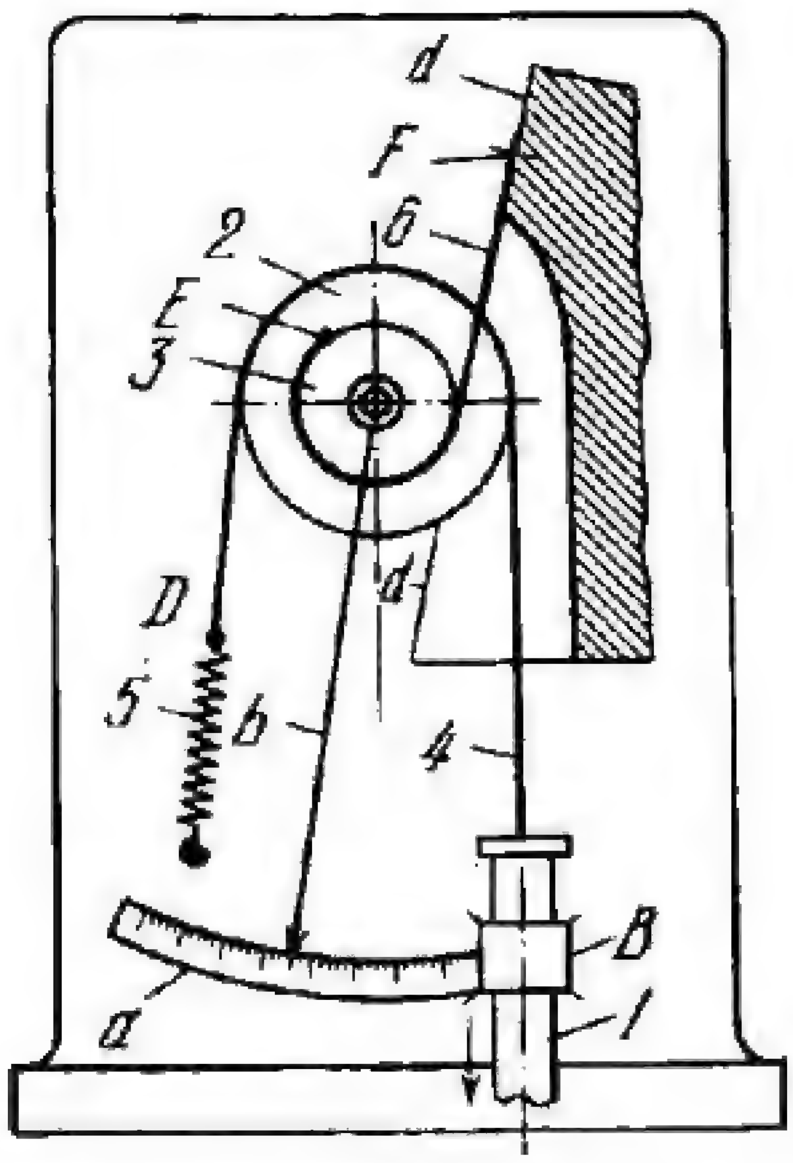
Pulley *4* with attached hand *5* rotates about fixed axis *A*. Flexible link *3* runs 360° around pulley *4* and is connected at point *B* to aneroid capsules (exhausted boxes) *1*, and at point *C* to spring *2*. When boxes *1* are deformed, hand *5* turns about axis *A* through an angle proportional to the deformation.

3523	FLEXIBLE-LINK THREAD GAUGING MECHANISM	SFL M



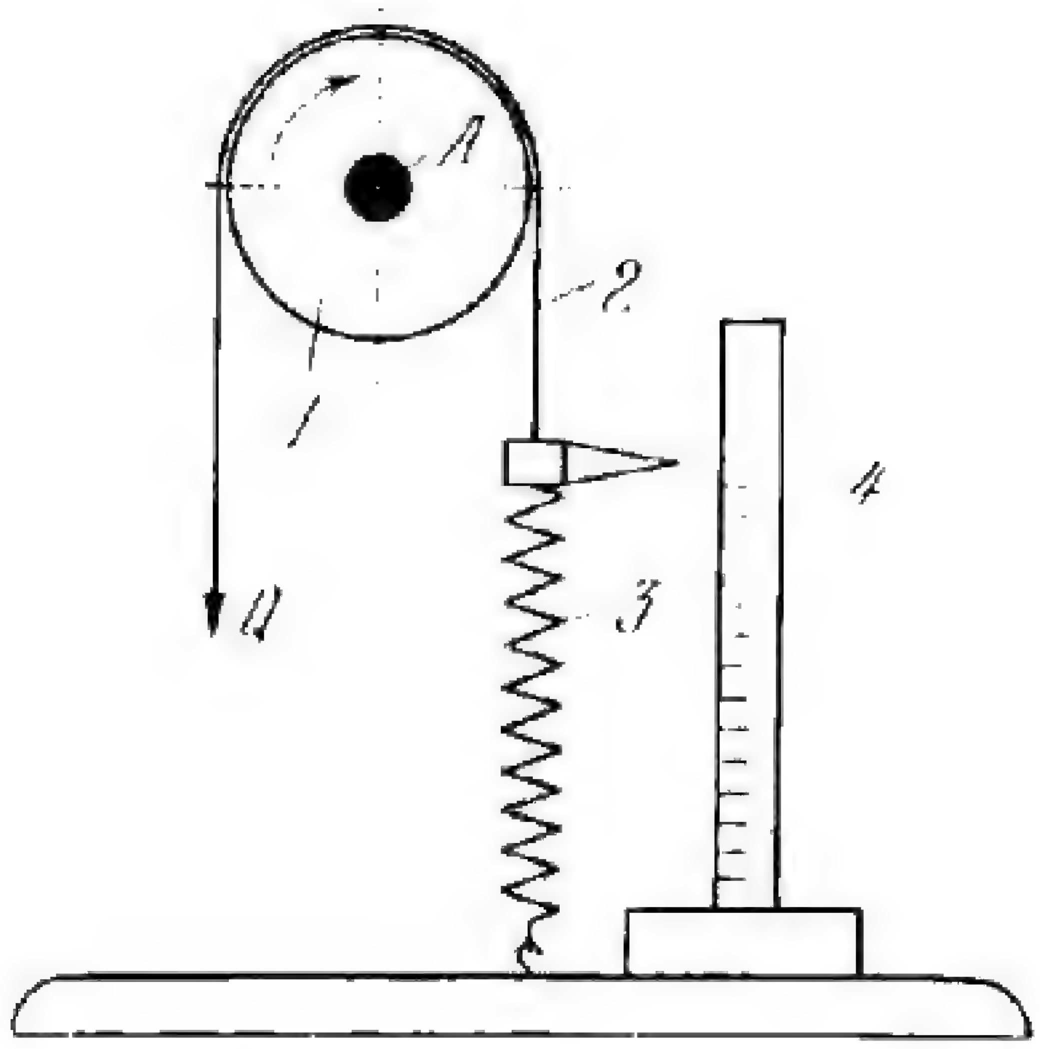
When handle *1* is pulled downward, spindle *2*, on which plug screw-thread gauge *a* is mounted, rotates so that the gauge is screwed into the workpiece. When handle *1* is released, weight *3* descends, turning spindle *2* in the opposite direction and screwing gauge *a* out of the workpiece. The mechanism is employed for checking small-diameter threads.

3524	FLEXIBLE-LINK MECHANICAL COMPARATOR MECHANISM	SFL M



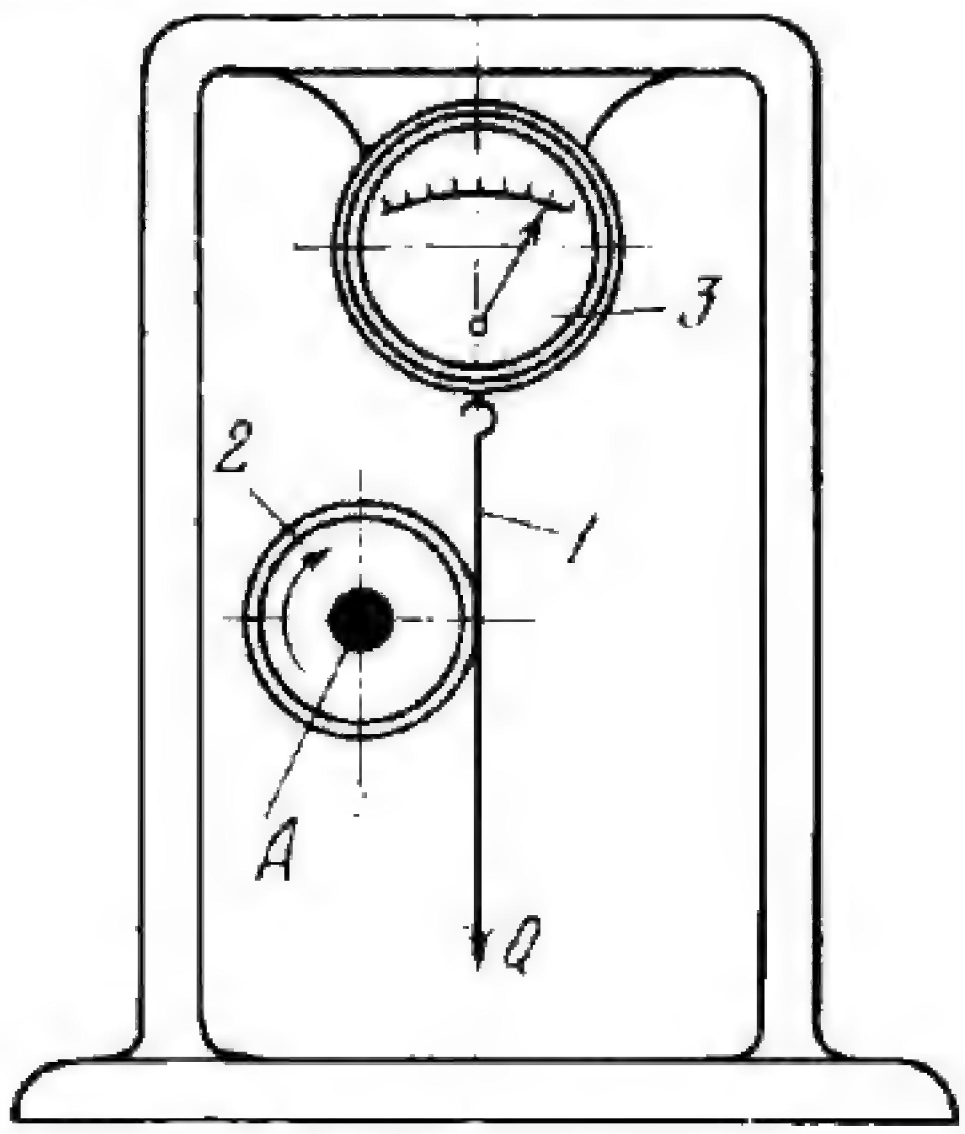
Measuring spindle *1* slides in fixed guide *B*. Two pulleys *2* and *3* make up a two-step drum. Steel band *4* runs over pulley *2* and has one end *D* attached to spring *5* and the other to measuring spindle *1*. Steel band *6* runs over pulley *3* and has one end *E* attached to pulley *3* and the other *F* attached to fixed flat surface *d*. When spindle *1* is displaced, pulley *3* rolls along band *6*, lying on flat surface *d*. This turns hand *b*, rigidly attached to pulley *3*, so that it indicates the motion of measuring spindle *1* on scale *a*.

3525	FLEXIBLE-LINK BRAKE DYNAMOMETER MECHANISM	SFL M



Flexible link *2*, attached at one end to spring *3*, runs over brake drum *1* which rotates about fixed axis *A*. The measured braking force *Q* is indicated by the hand on scale *4*.

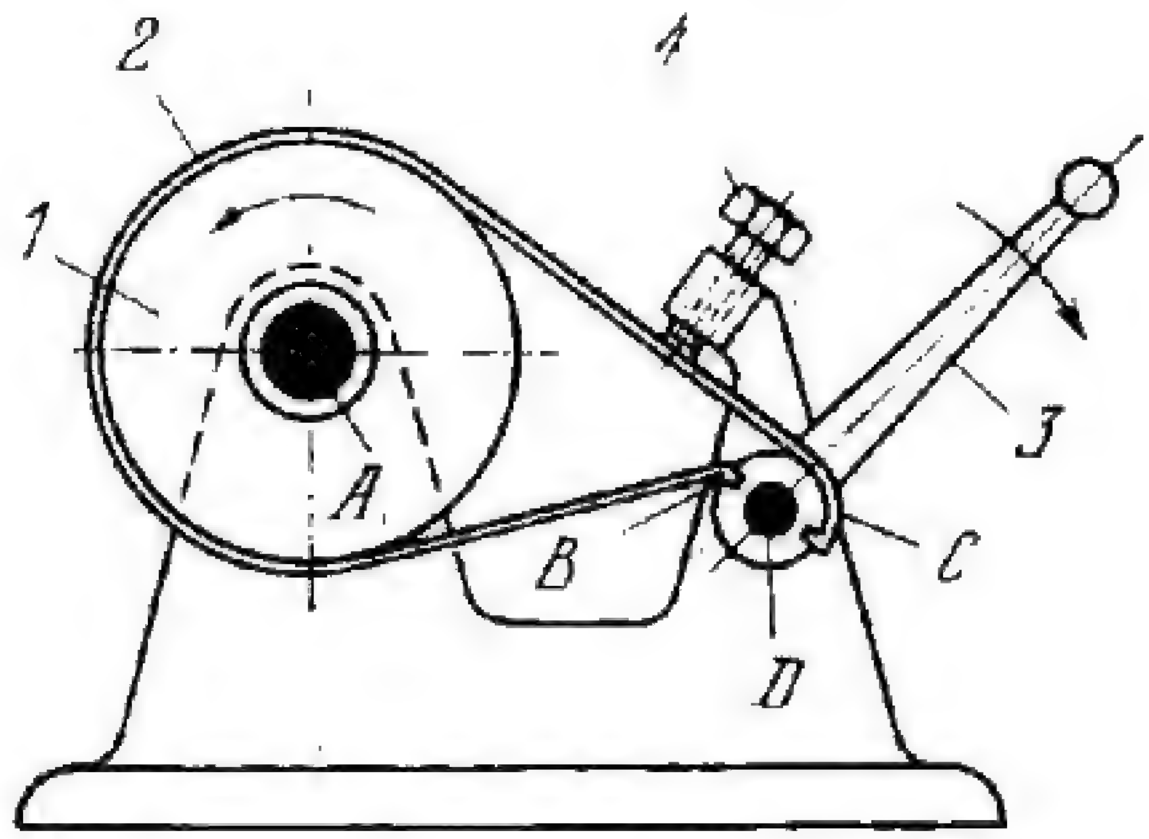
3526	FLEXIBLE-LINK BRAKE DYNAMOMETER MECHANISM	SFL M



Flexible link *1* is attached at one end to spring balance *3* and runs 360° around brake drum *2* which rotates about fixed axis *A*. The measured braking force *Q* is indicated on the scale of balance *3*.

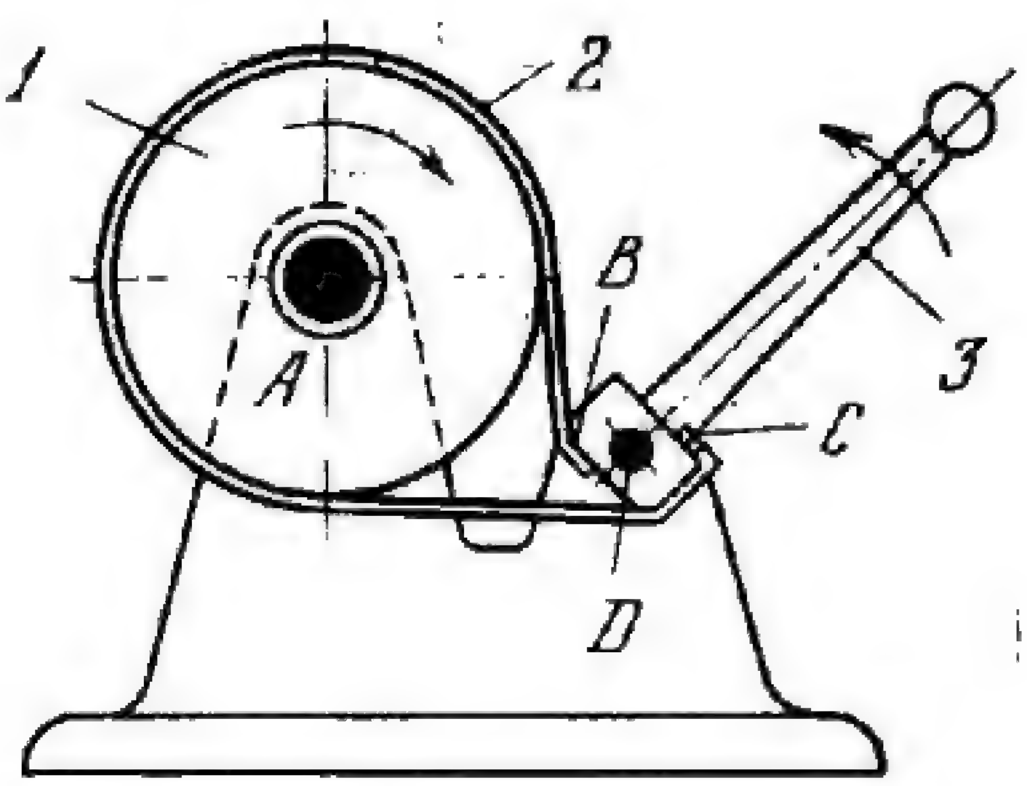
6. BRAKE MECHANISMS (3527 and 3528)

3527	ADJUSTABLE BAND-BRAKE MECHANISM	SFL Br



Brake drum *1* rotates about fixed axis *A*. Flexible band *2* runs over drum *1* and its ends are attached at points *B* and *C* to lever *3* which turns about fixed axis *D*. Drum *1* is braked by turning lever *3* clockwise. The tension of band *2* can be adjusted by screw *4*.

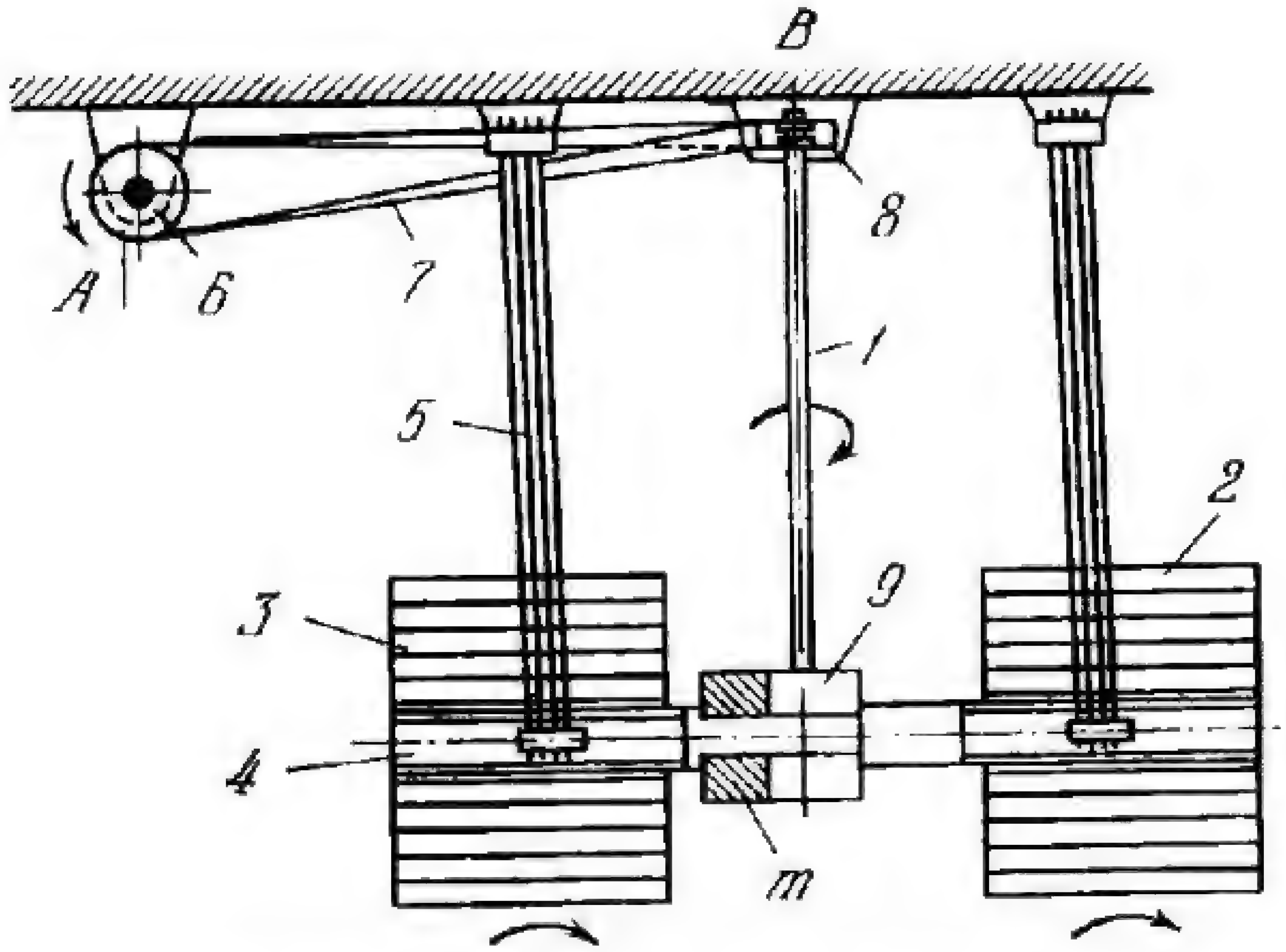
3528	BAND-BRAKE MECHANISM	SFL Br



Brake drum *1* rotates about fixed axis *A*. Flexible band *2* runs over drum *1* and its ends are attached at points *B* and *C* to lever *3* which turns about fixed axis *D*. Drum *1* is braked by turning lever *3* counterclockwise.

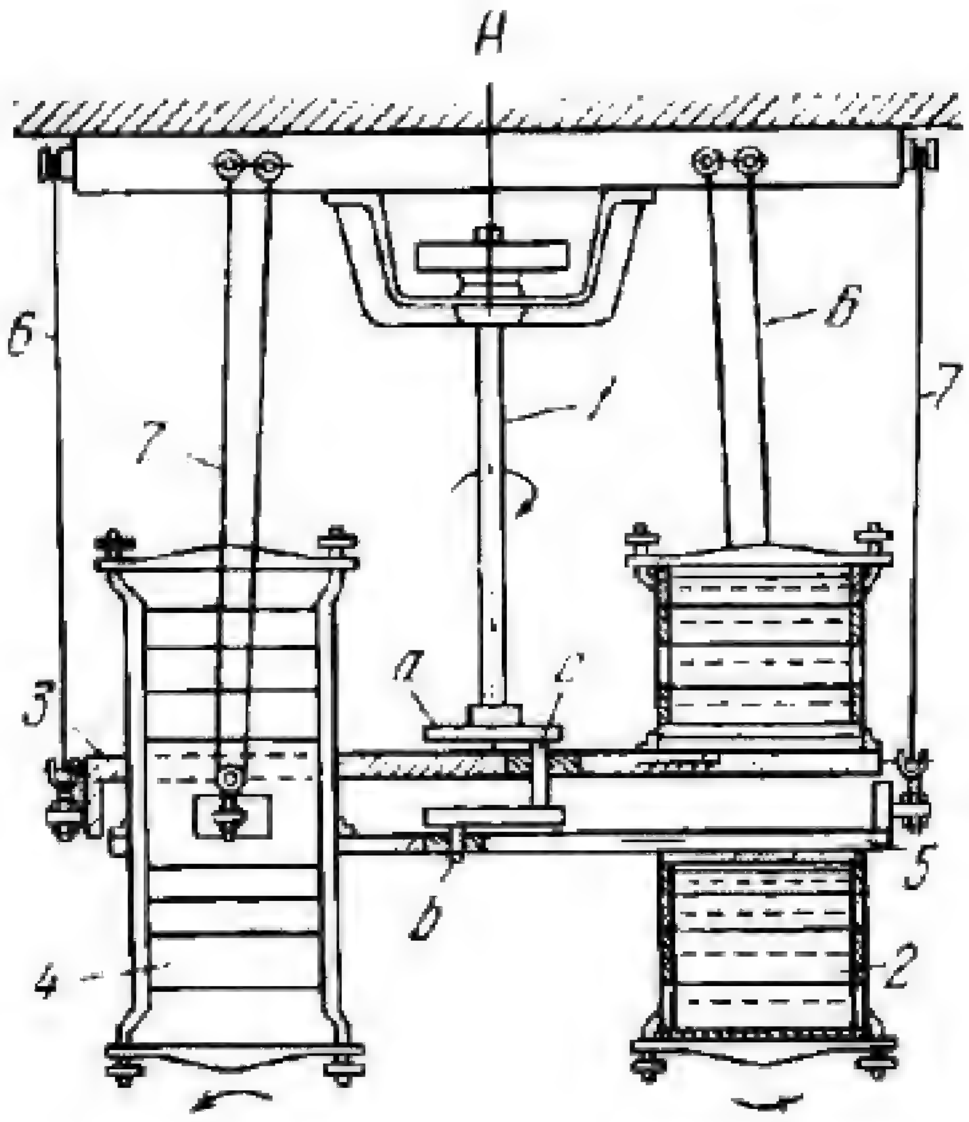
7. MECHANISMS OF OTHER FUNCTIONAL DEVICES (3529, 3530 and 3531)

3529	FLEXIBLE-SHAFT SCREENING MECHANISM	SFL FD



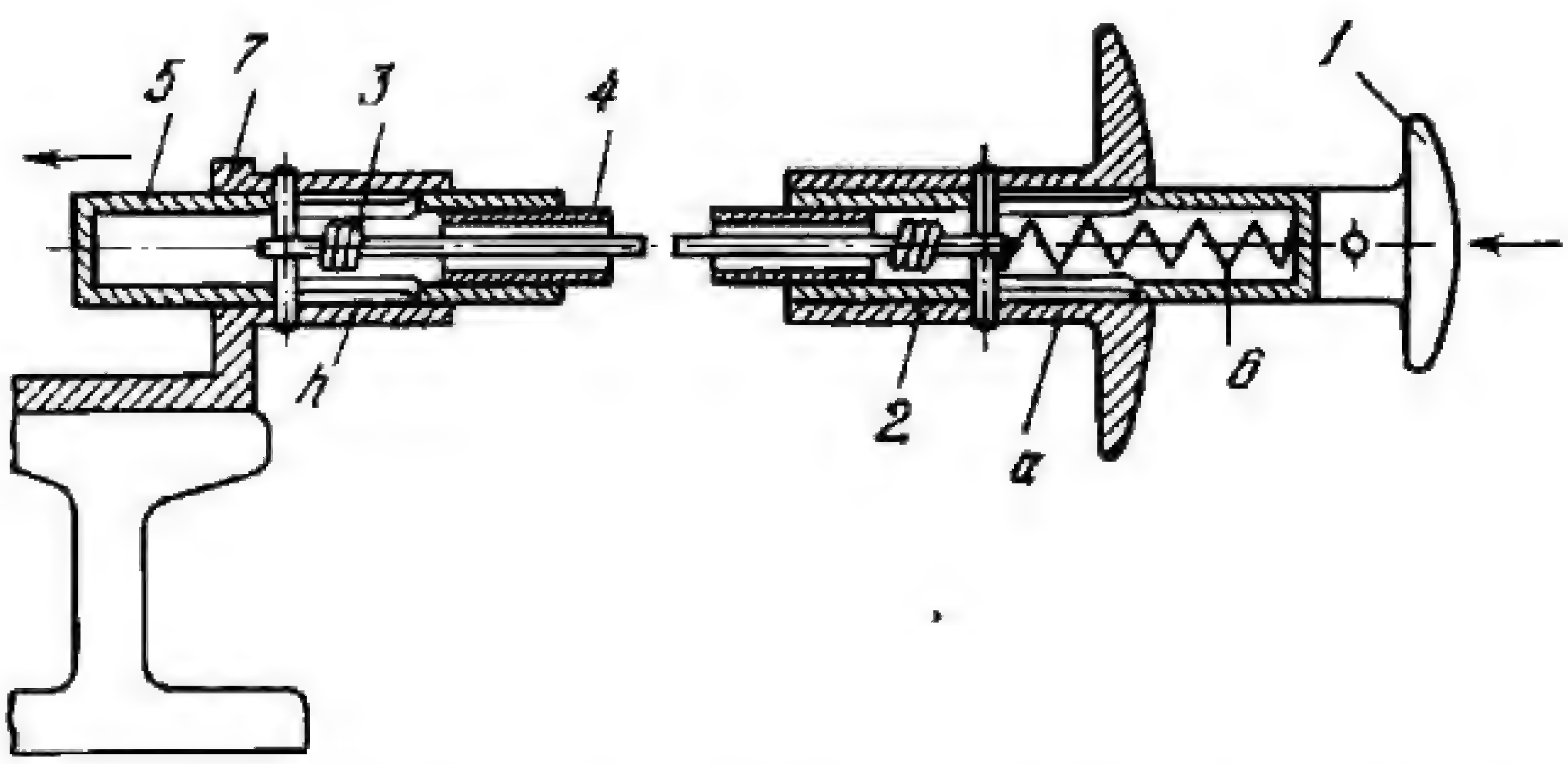
Pulley *6* rotates about fixed axis *A* and, through quarter-turn belt *7*, rotates pulley *8* about fixed axis *B*. Pulley *8* is rigidly attached to flexible shaft *1*. Eccentric *9* with unbalanced mass *m* is mounted at the end of shaft *1* and is connected by a turning pair to frame *4*. The bodies of screens *2* and *3* are attached to frame *4* which is suspended on flexible links (ropes) *5*. When shaft *1* rotates, frame *4* has a circular motion due to the action of unbalanced mass *m*.

3530	FLEXIBLE-LINK SCREENING MECHANISM	SFL FD



Shaft *1* rotates about fixed axis *A*. Rigidly mounted on shaft *1* is double-throw crankshaft *a* with crank-pins *c* and *b* which are connected by turning pairs to frames *3* and *5*. The body of screen *4* is attached to frame *3* and that of screen *2* to frame *5*. Frame *3* is suspended on flexible links (ropes) *6*, and frame *5* on flexible links (ropes) *7*. When shaft *1* rotates, the bodies of screens *2* and *4* have circular motions.

3531	FLEXIBLE-LINK SHUTTER RELEASE MECHANISM OF A CAMERA	SFL FD



Stud *1* slides in guide *a* of socket *2*. When stud *1* is pressed, sleeve *5*, connected to stud *1* by flexible link (tube) *4*, moves along guide *h* of socket *7*, releasing the camera shutter. Flexible wire *3* restricts the deformation of link *4*, making it stiff enough to transmit a force. Spring *6* returns stud *1* to its initial position.

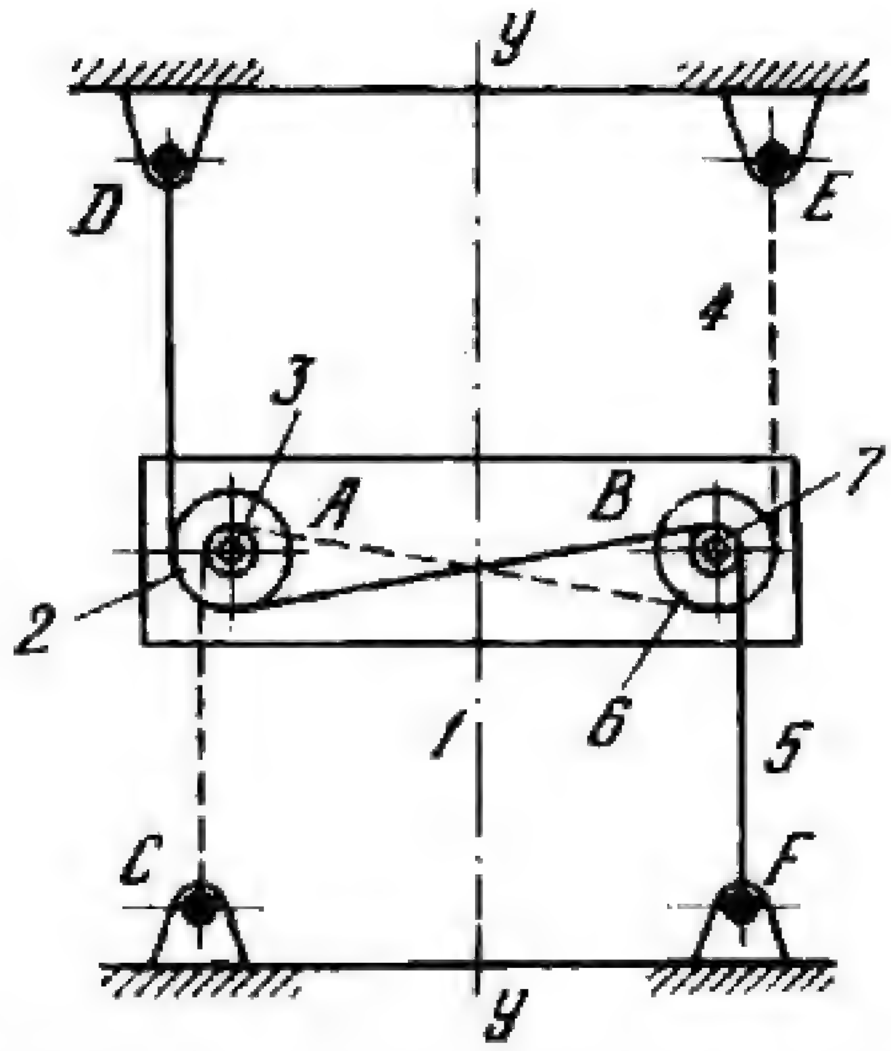
SECTION TWENTY-SEVEN

Complex Flexible-Link Mechanisms CFL

1. General-Purpose Multiple-Link Mechanisms ML (3532 through 3551)
2. Mechanisms for Mathematical Operations MO (3552 and 3553)
3. Switching, Engaging and Disengaging Mechanisms SE (3554, 3555 and 3556)
4. Mechanisms of Materials Handling Equipment MH (3557 through 3562)
5. Mechanisms for Generating Curves Ge (3563 and 3564)
6. Mechanisms of Measuring and Testing Devices M (3565)
7. Differential Flexible-Link Mechanisms DF (3566 through 3583)
8. Mechanisms of Other Functional Devices FD (3584 through 3590)

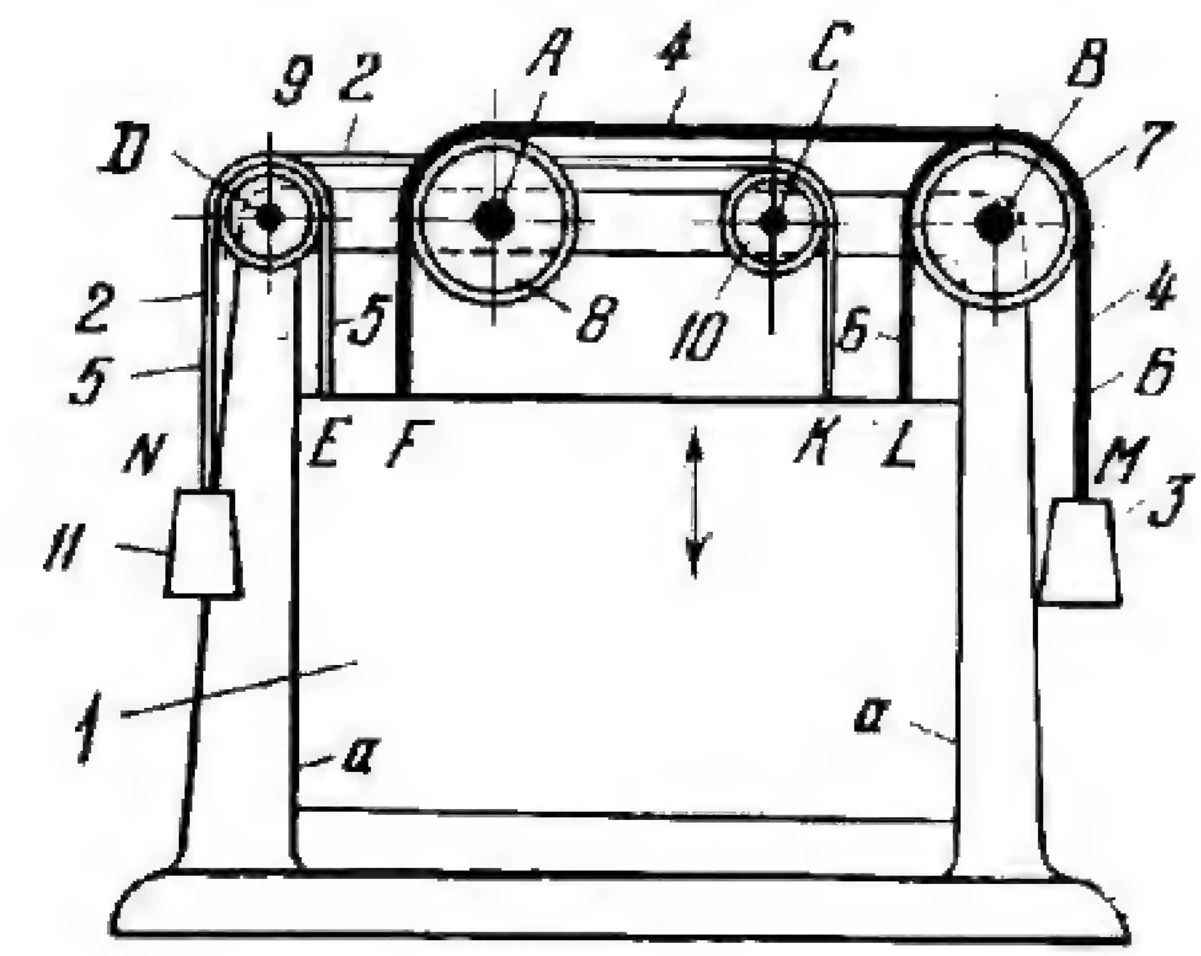
1. GENERAL-PURPOSE MULTIPLE-LINK MECHANISMS (3532 through 3551)

3532	PARALLEL RULING STRAIGHTEDGE MECHANISM	CFL ML



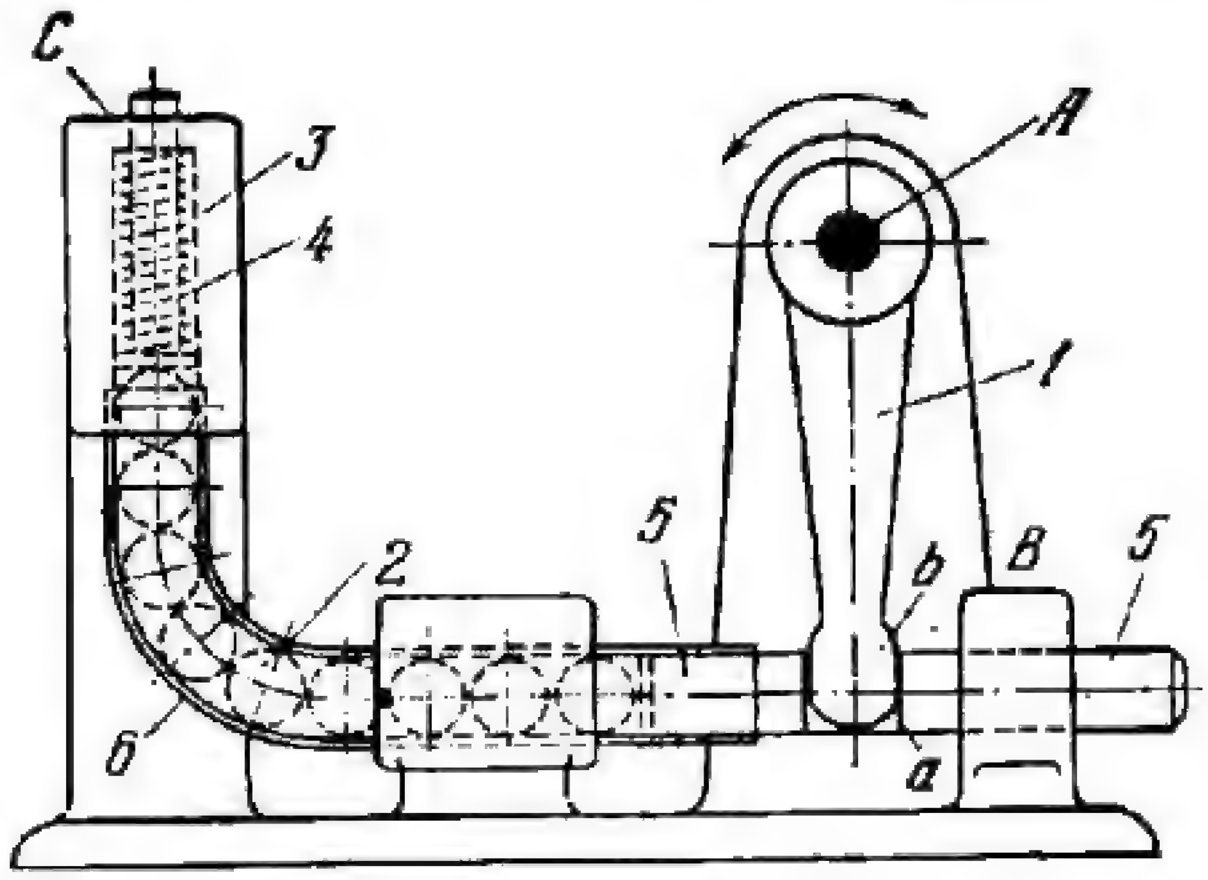
Identical pulleys *2* and *6* rotate about axes *A* and *B* of the straightedge. Rigidly attached to pulleys *2* and *6* are identical pulleys *3* and *7*. Flexible link (cable) *4*, shown by a dash line, runs over pulleys *3* and *6*, and is attached to the base (drawing board) at points *C* and *E*. Flexible link (cable) *5*, runs over pulleys *2* and *7*, and is attached to the base (drawing board) at points *D* and *F*. Straightedge *1*, on which the axles of pulleys *2*, *3*, *6* and *7* are mounted, travels along axis *y-y* with translational motion, so that its edges remain parallel to axis *x-x*.

3533	TRANSLATIONAL RAISING MECHANISM FOR A DRAWING BOARD	CFL ML



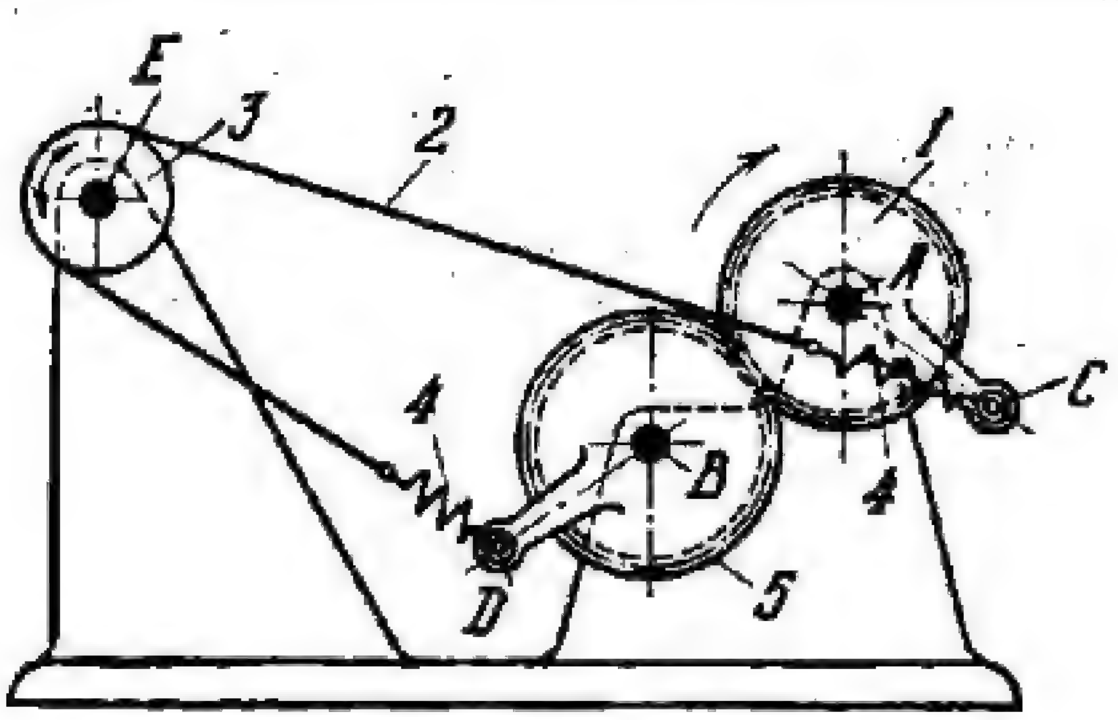
Drawing board *1* slides along fixed guides *a-a*. Two identical pulleys *7* and *8* rotate about fixed axes *B* and *A*, and two identical pulleys *9* and *10* rotate about fixed axes *D* and *C*. Flexible link (cable) *4*, attached to drawing board *1* at point *F*, runs over pulleys *8* and *7*, and its other end *M* is attached to counterbalancing weight *3*. Flexible link (cable) *2*, attached to board *1* at point *K*, runs over pulleys *10* and *9*, and its other end *N* is attached to counterbalancing weight *11*. Flexible links (cables) *5* and *6*, attached to board *1* at points *E* and *L*, run over pulleys *9* and *7*, and their other ends, at points *N* and *M*, are attached to weights *11* and *3*. Thus two flexible links *4* and *6* run over pulley *7*, and two, *2* and *5*, run over pulley *9*. Weights *3* and *11* are selected so that drawing board *1* is in equilibrium in any position with respect to the base.

3534	STEEL BALL MOTION TRANSMITTING MECHANISM	CFL ML



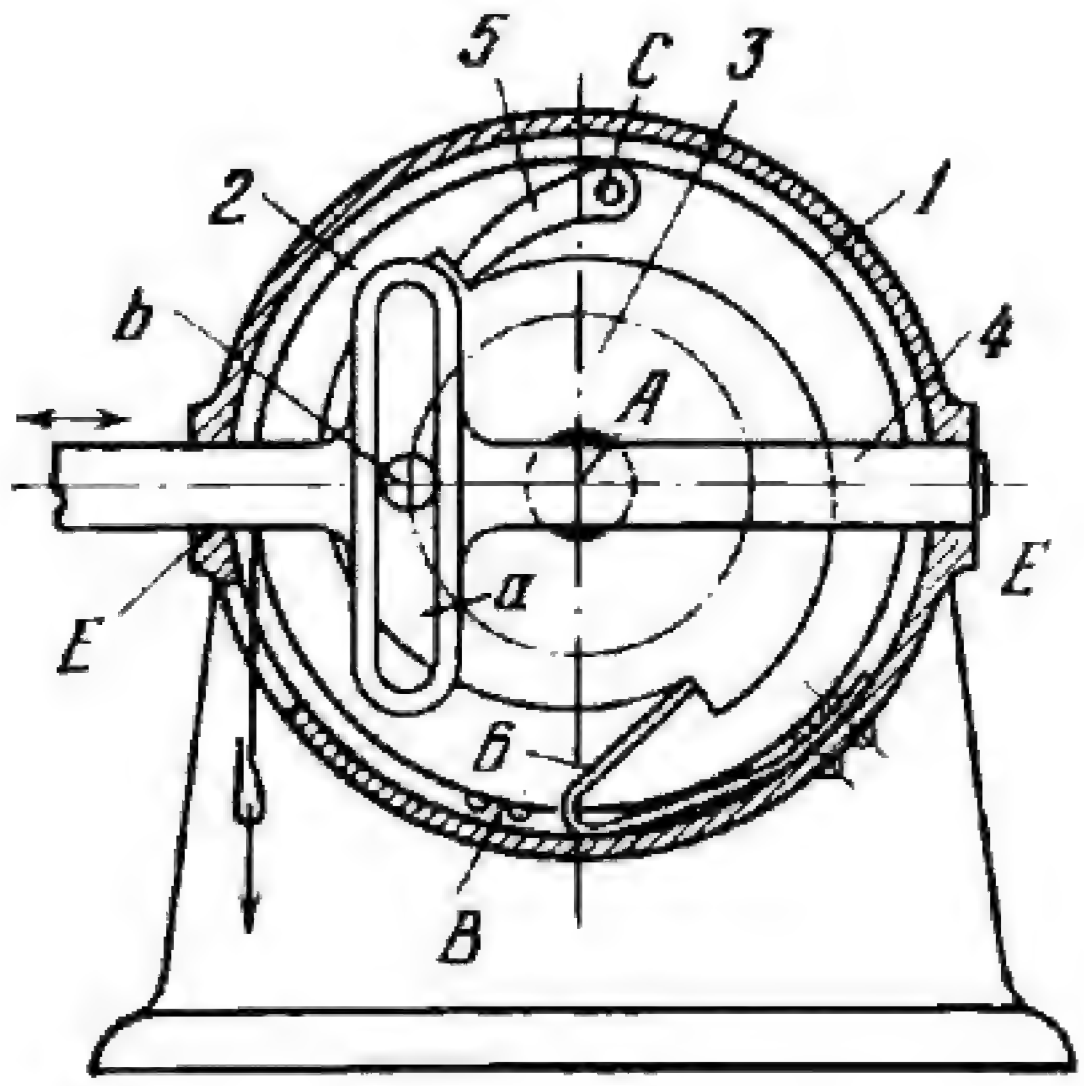
Lever 1 oscillates about fixed axis A and has head b which engages slot a in link 5. Link 5 reciprocates in fixed guide B and acts on steel balls 2, confined in flexible tube 6, forcing the balls up in the tube and causing plunger 3 to move upward in fixed guide C. Plunger 3 is returned to its initial position by spring 4 which also keeps the balls in contact with link 5.

3535	GEAR-DRIVE ROLLER OSCILLATION MECHANISM	CFL ML



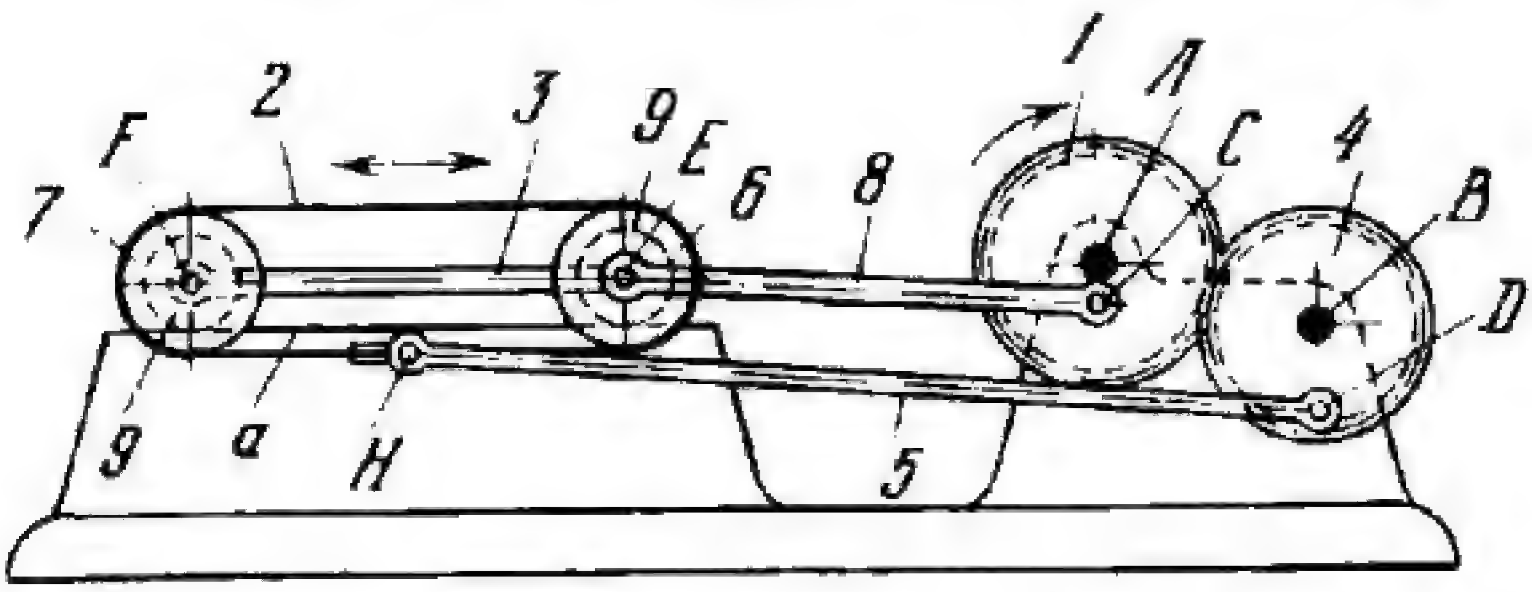
Two meshing spur gears 1 and 5 rotate about fixed axes A and B. Roller 3 rotates about fixed axis E. Flexible link 2 has springs 4 at its ends and is attached at points C and D to gears 1 and 5. Link 2 runs over roller 3. When gear 1 rotates continuously in one direction, roller 3 oscillates. Springs 4 maintain constant tension of flexible link 2.

3536	FLEXIBLE-LINK RATCHET-TYPE SLIDE RECIPROCATING MECHANISM	CFL ML



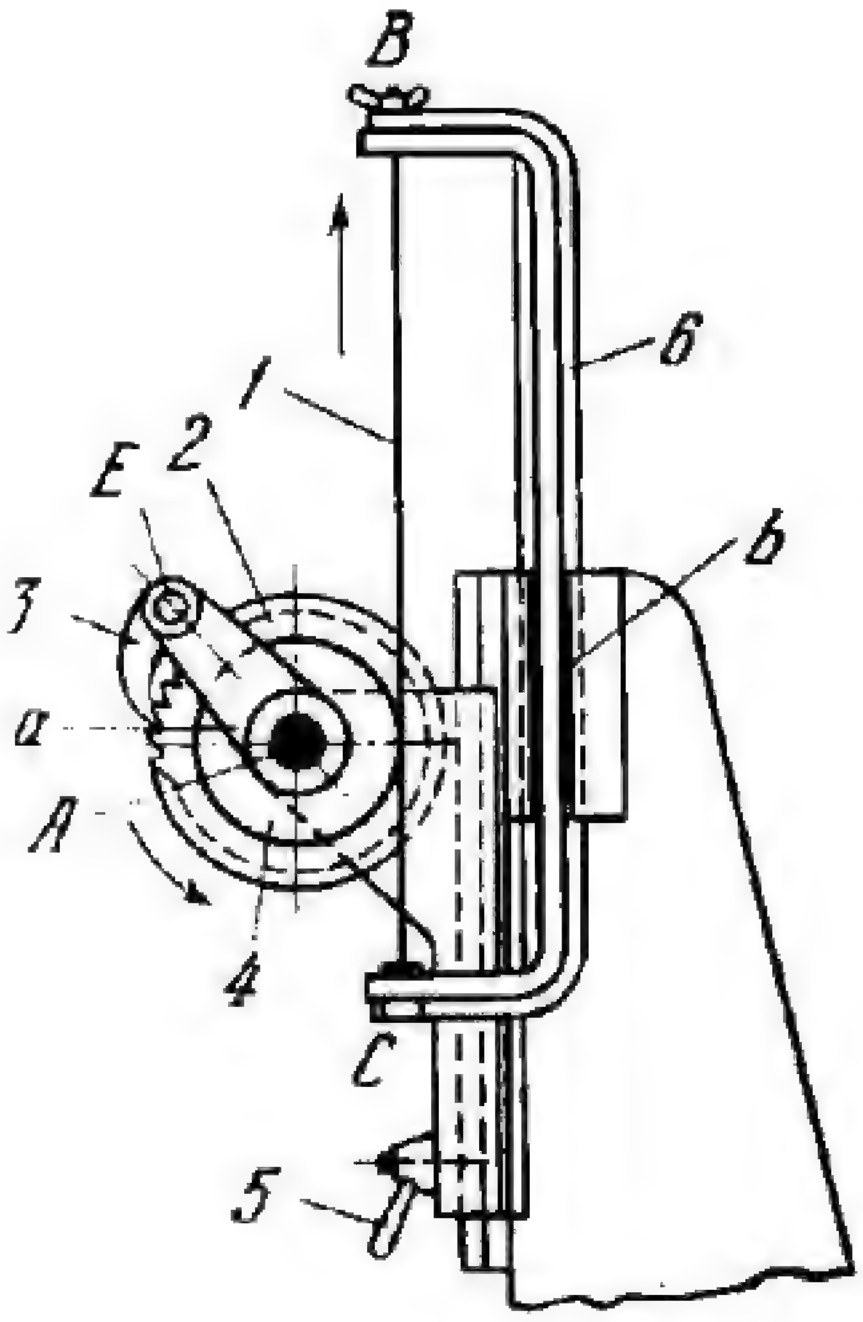
Drum *2* rotates about fixed axis *A* and carries pivoted pawl *5* turning about axis *C*. Flexible link *1* runs over drum *2* and is attached to the drum at point *B*. Ratchet wheel *3* rotates freely about axis *A*. Slotted slide *4* reciprocates in fixed guides *E-E* and has slot *a* along which pin *b* of ratchet wheel *3* slides. When the free end of link *1* travels downward, drum *2* turns counterclockwise and pawl *5* turns ratchet wheel *3* one half revolution. At this, pin *b* moves slide *4* horizontally. When link *1* is released from its load, drum *2* is returned by a spiral spring (not shown) to its initial position. During this motion, ratchet wheel *3* is held stationary by spring pawl *6*.

3537	FLEXIBLE-LINK MECHANISM FOR COMPLEX MOTION	CFL ML



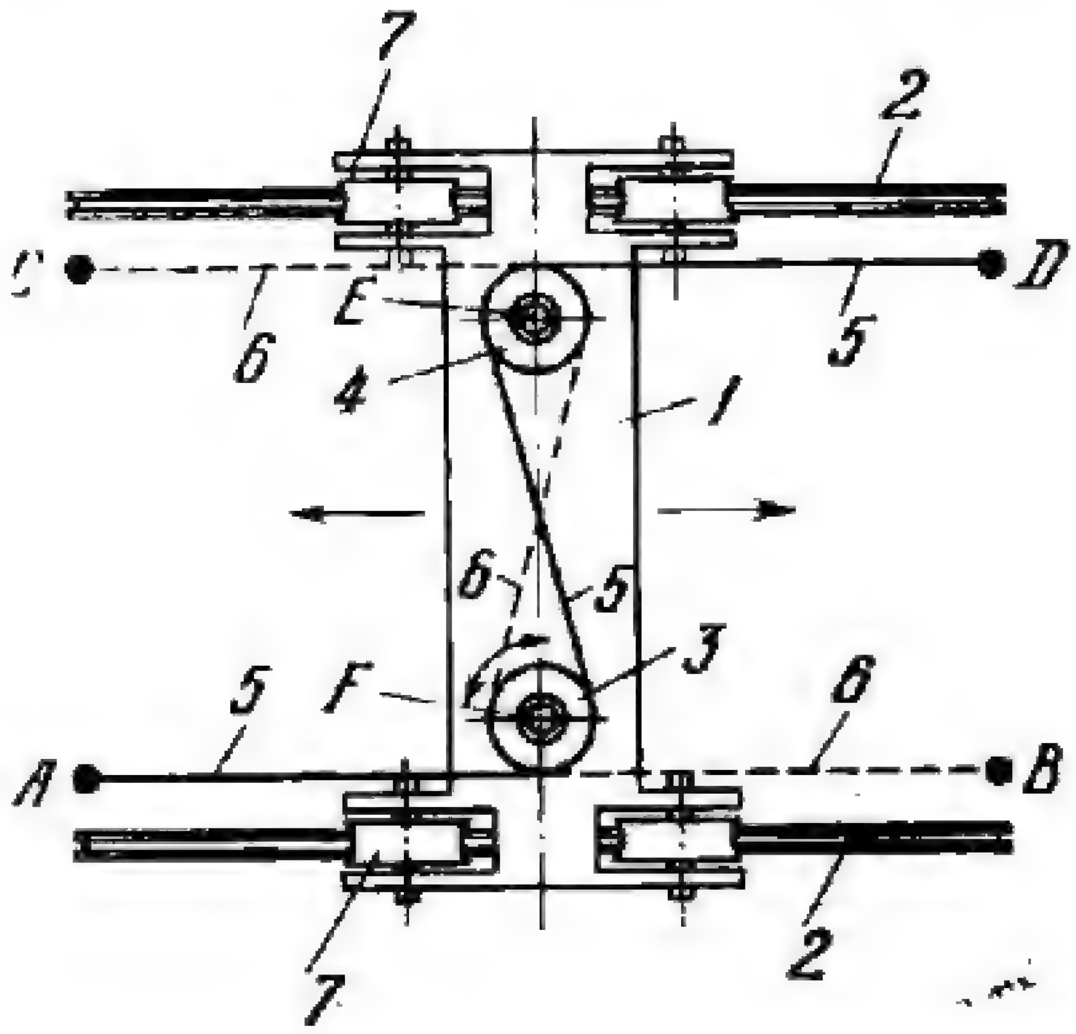
Two meshing spur gears *1* and *4* rotate about fixed axes *A* and *B*. Connecting rod *8* is connected by turning pairs *C* and *E* to gear *1* and to carriage *3* whose wheels *9* roll along fixed horizontal plane *a*. Two identical pulleys *6* and *7* rotate freely about axes *E* and *F* of carriage *3*. Connecting rod *5* is connected by turning pairs *D* and *H* to gear *4* and to flexible link *2* which runs over pulleys *6* and *7*. When gear *1* rotates continuously in one direction, carriage *3* reciprocates along plane *a* and flexible link *2* has a complex motion consisting of reciprocation with carriage *3* and motion with respect to carriage *3* caused by connecting rod *5* and gear *4*.

3538	FLEXIBLE-LINK RATCHET-TYPE INTERMITTENT MOTION MECHANISM	CFL ML



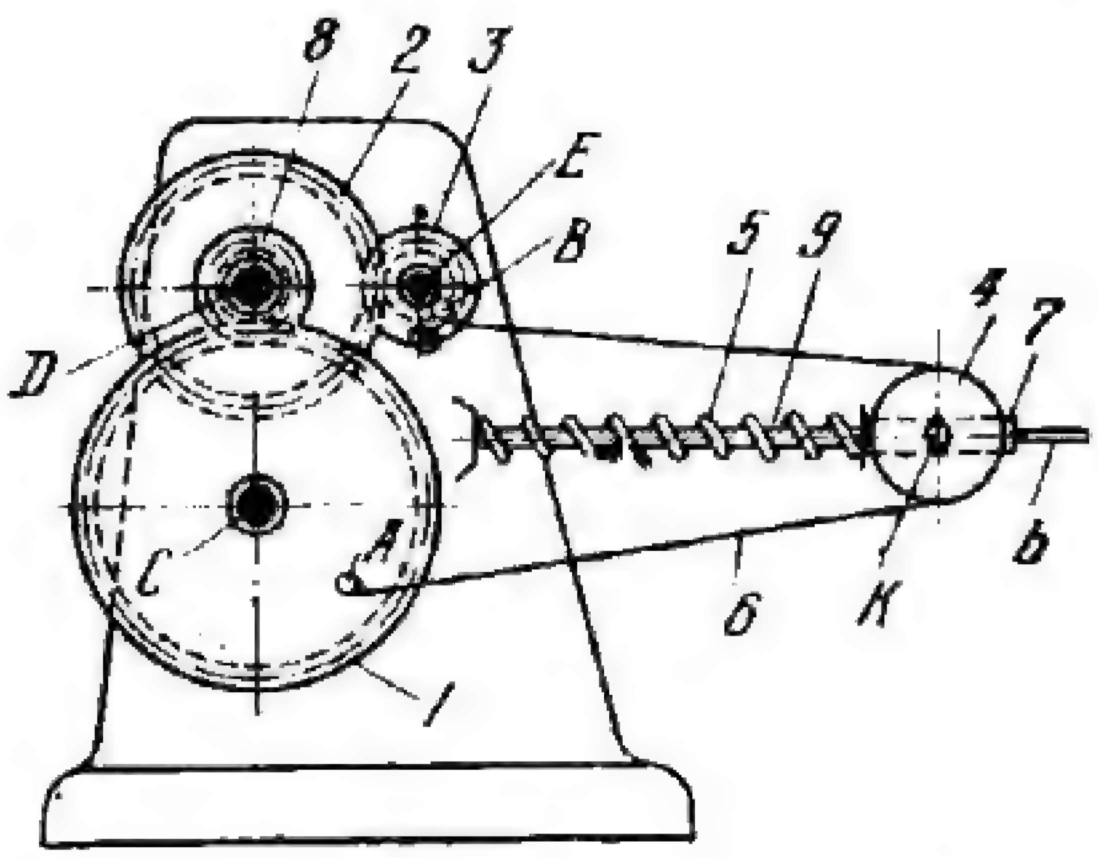
Slide *6* reciprocates in fixed guide *b*. Flexible link *1* has its ends attached at points *B* and *C* to slide *6*, and runs 360° around pulley *4* which rotates about fixed axis *A*. Rigidly attached to pulley *4* is lever *a* which is connected by turning pair *E* to pawl *3*. Pawl *3* engages the teeth of ratchet wheel *2* which rotates freely about axis *A*. When slide *6* reciprocates, ratchet wheel *2* is rotated intermittently counterclockwise by pawl *3*. The bracket holding the axle at axis *A* can be adjusted vertically and clamped in the required position by nut *5*.

3539	FLEXIBLE-LINK CARRIAGE TRAVEL MECHANISM	CFL ML



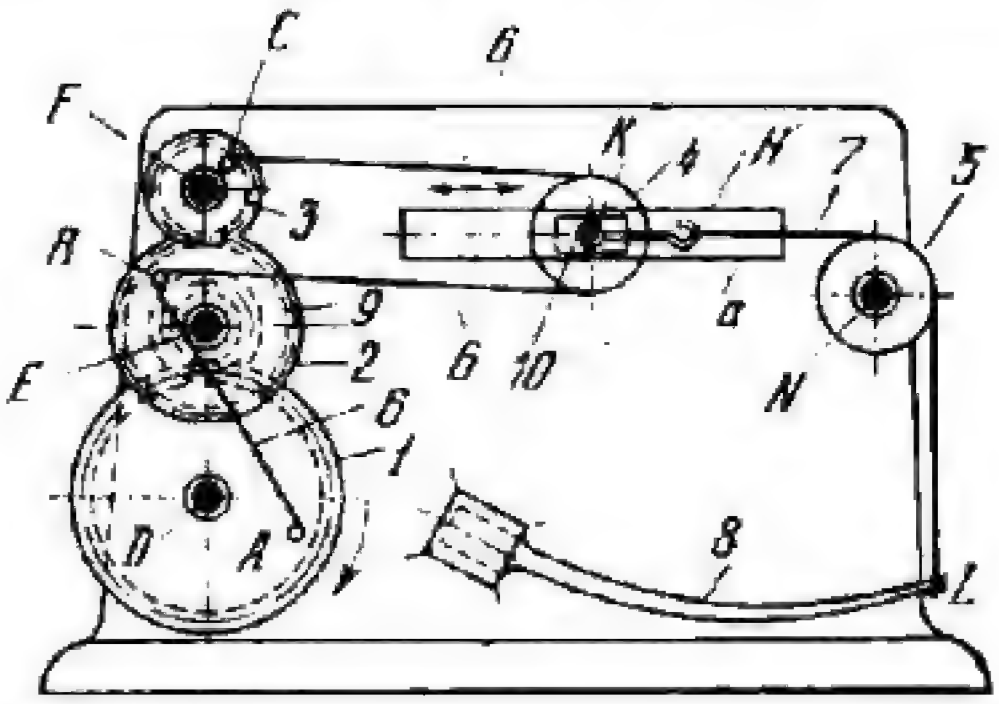
Carriage *1* with wheels *7* rolls along fixed rails *2*. Two identical pulleys *3* and *4* rotate about axes *F* and *E* of carriage *1*. Flexible links *5* and *6*, attached with their ends at fixed points *A*, *D*, *B* and *C*, run crosswise over pulleys *3* and *4*. When either pulley *3* or *4* is rotated, carriage *1* travels along rails *2*.

3540	GEAR-DRIVE SLIDE RECIPROCATING MECHANISM	CFL ML



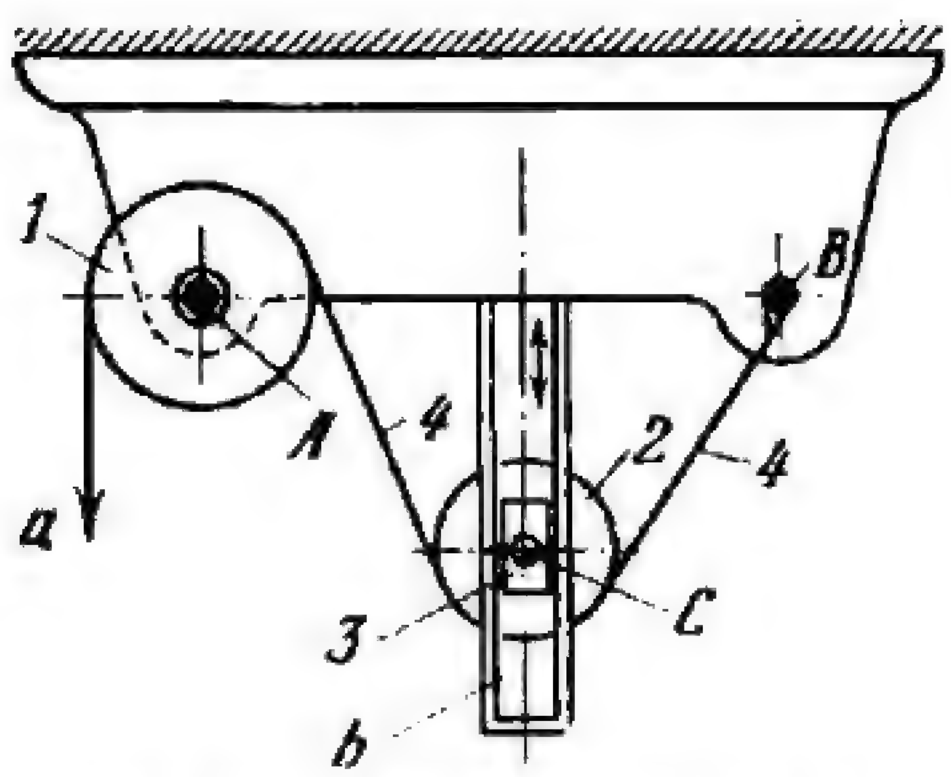
Driving gear *1* rotates about fixed axis *C* and meshes with gear *8* which rotates about fixed axis *D* and is rigidly attached to gear *2*. Gear *2* meshes with gear *3* which rotates about fixed axis *E*. Flexible link *6* is attached at points *A* and *B* to gears *1* and *3*, and runs over pulley *4* which is connected by turning pair *K* to slide *7*. Slide *7* reciprocates along fixed guide *b* of bar *9* mounted on the base. Spring *5* tensions link *6*. When gear *1* rotates, slide *7* reciprocates along guide *b*.

3541	GEAR-DRIVE SLIDE RECIPROCATING MECHANISM	CFL ML



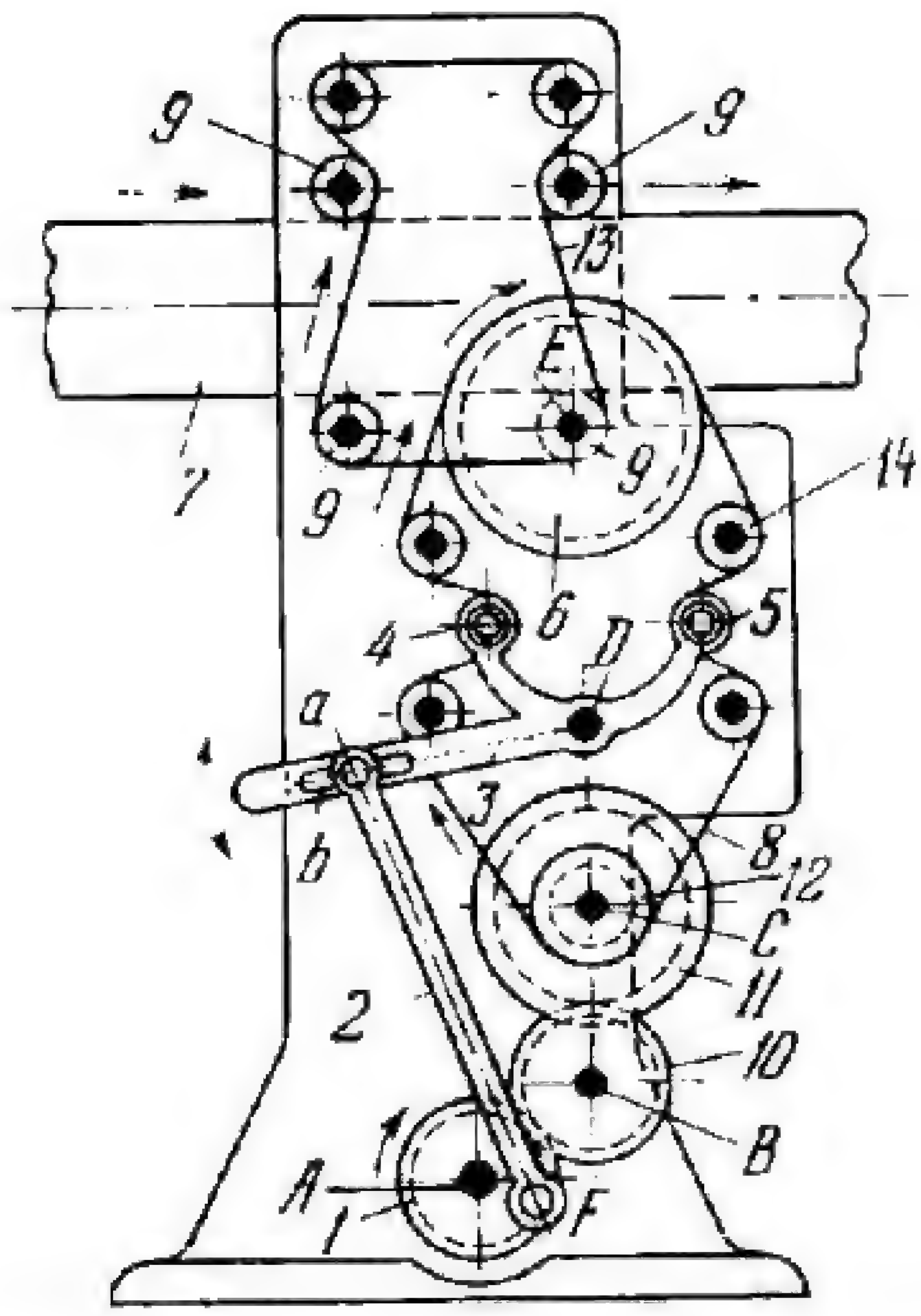
Driving gear *1* rotates about fixed axis *D* and meshes with gear *9* which rotates about fixed axis *E* and is rigidly attached to gear *2*. Gear *2* meshes with gear *3* which rotates about fixed axis *F*. Flexible link *6* is attached at points *A* and *C* to gears *1* and *3*, and runs over pin *B* of gear *2* and over pulley *4*. Pulley *4* is connected by turning pair *K* to slide *10* and travels with the slide along fixed guide *a*. Link *6* is tensioned by flexible link *7* which runs over pulley *5*, rotating about fixed axis *N*, and is attached at point *L* to flat spring *8*. When gear *1* rotates, slide *10* reciprocates along guide *a*.

3542	FLEXIBLE-LINK SLIDE TRAVEL MECHANISM	CFL ML



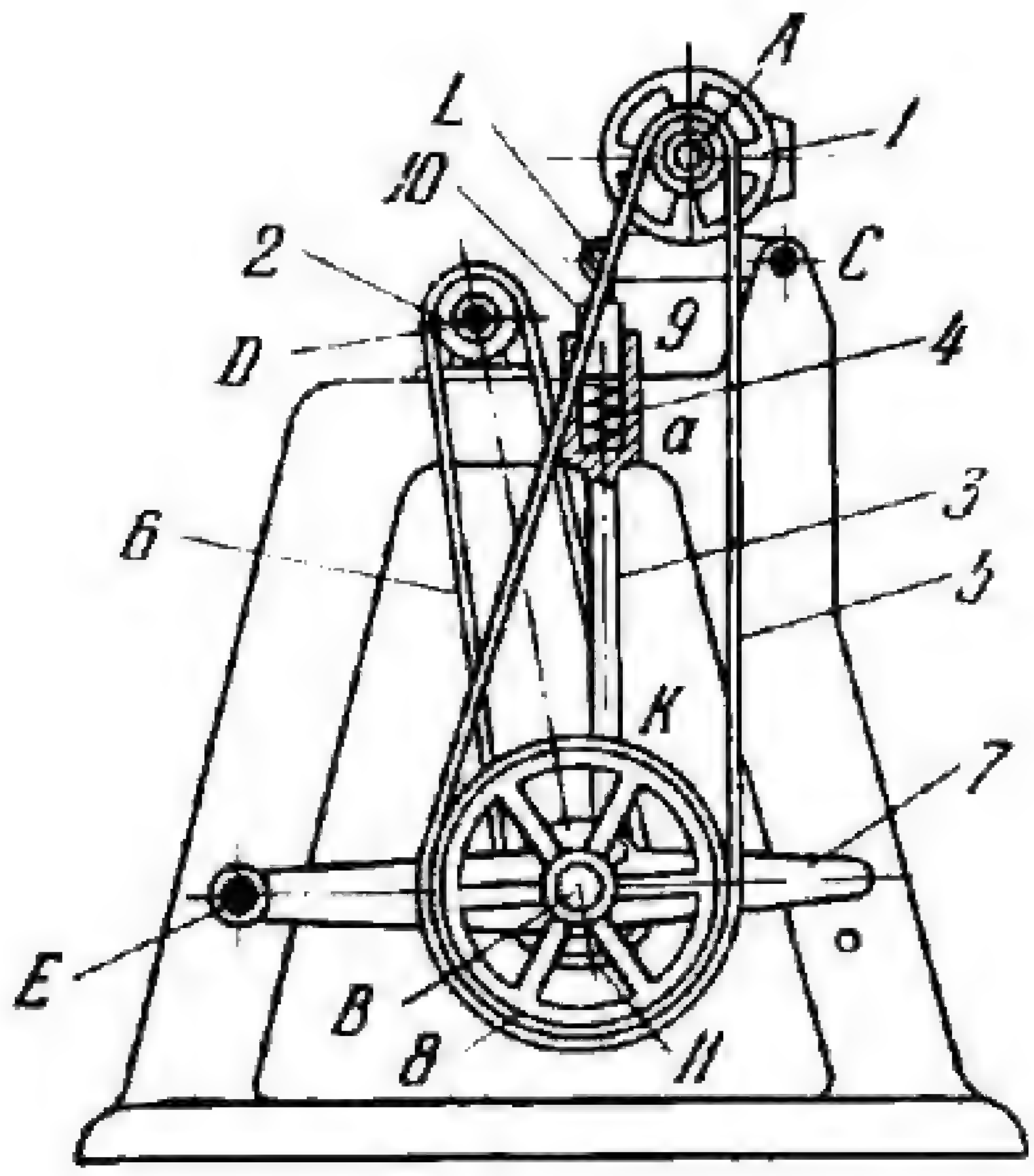
Pulley *1* rotates about fixed axis *A*. Slide *3* moves along fixed guide *b*. Pulley *2* is connected by turning pair *C* to slide *3*. Flexible link *4* is attached with one end at fixed point *B* and runs over pulleys *2* and *1*. If end *a* of link *4* is pulled downward, slide *3* travels upward in guide *b*. Link *4* is tensioned by the weight of pulley *2* and slide *3*.

3543	FLEXIBLE-LINK PERIODICALLY ACCELERATED FEED MECHANISM	CFL ML



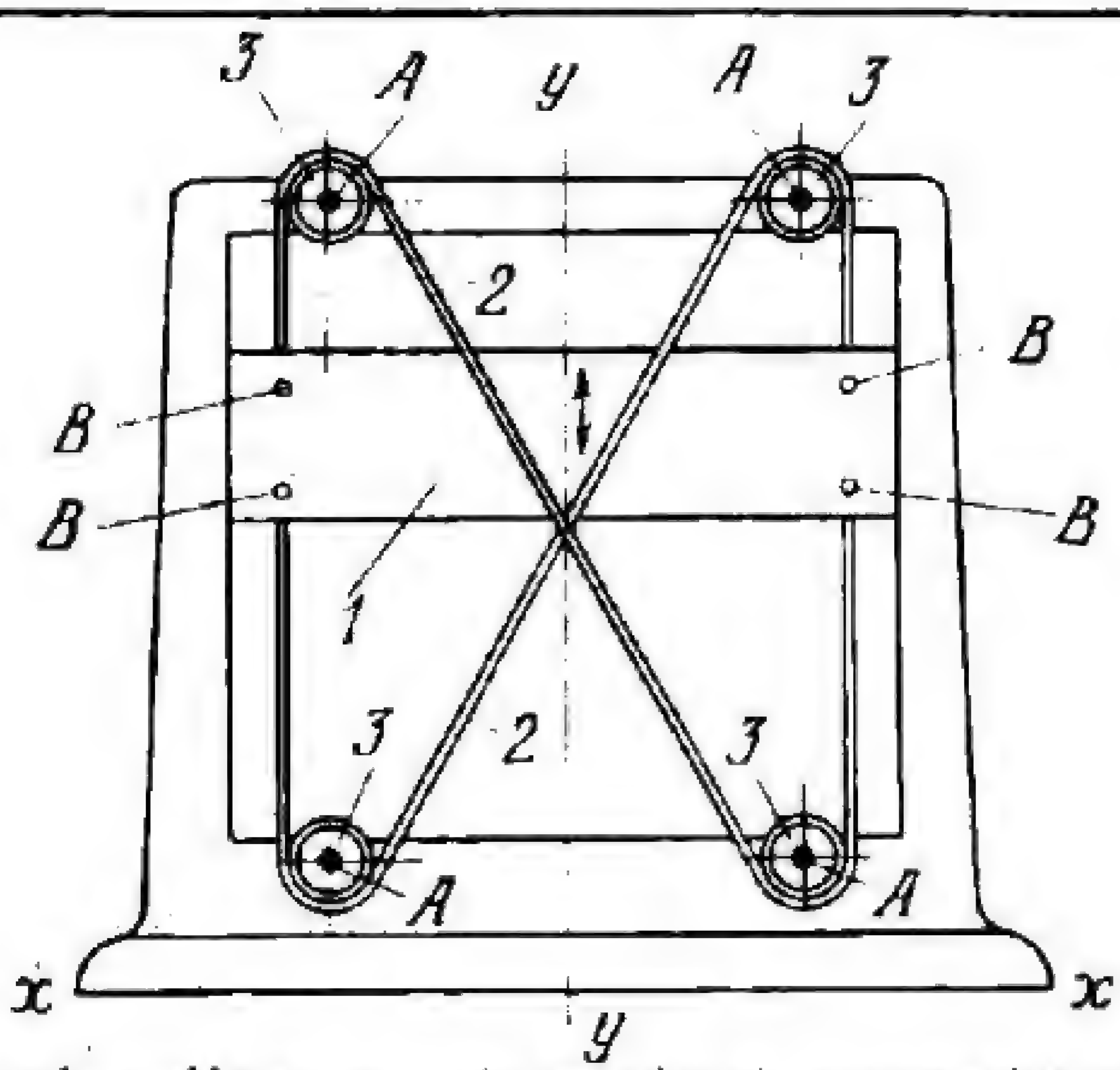
Driving gear *1* rotates about fixed axis *A* and transmits rotation through intermediate gears *10* and *11*, rotating about fixed axes *B* and *C*, to chain sprocket *12*, which is rigidly attached to gear *11*. Chain *8* runs over sprockets *12* and *6*, over four pulleys *14*, rotating about fixed axes, and over pulleys *4* and *5* carried by swinging arm *3*. Thus chain *8* rotates sprocket *6* about fixed axis *E*. Arm *3* is oscillated about fixed axis *D* by connecting rod *2* which is connected by turning pair *F* to gear *1*. Flexible link *13* runs over rollers *9*, one of which is rigidly attached to sprocket *6*. When gear *1* rotates continuously at uniform speed, arm *3* oscillates and rollers *4* and *5* change the motion of flexible link *8* so that it is periodically accelerated and retarded. This motion is transmitted to rollers *9* which correspondingly vary the feed motion of workpiece *7*. The required feeding motion can be obtained by adjusting pin *a* of connecting rod *2* along slot *b* of arm *3*.

3544	LEVER-TYPE TENSIONING DEVICE FOR A BELT DRIVE	CFL ML



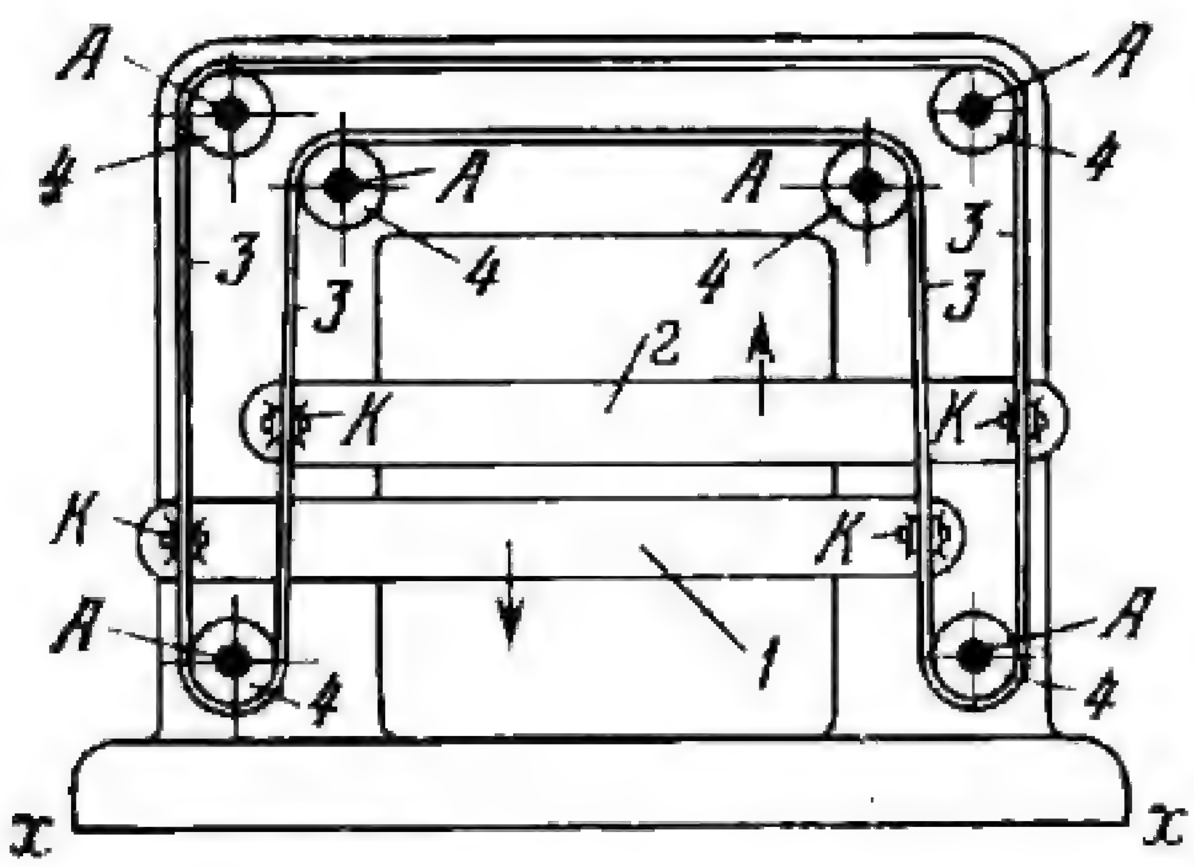
Belt *5* runs over two pulleys *1* and *8* which rotate about axis *A* of motor base *9*, turning about fixed axis *C*, and about axis *B* of rocker arm *7*, turning about fixed axis *E*. Belt *6* runs over pulley *11*, rigidly attached to pulley *8*, and over pulley *2* which rotates about fixed axis *D*. Belts *5* and *6* are tensioned by spring *4* which is enclosed in sleeve *a* of rod *3*. Rod *3* is connected by turning pair *K* to arm *7* and by a sliding pair to plunger *10* which, in turn, is connected by turning pair *L* to motor base *9*.

3545	PARALLEL RULING STRAIGHTEDGE MECHANISM	CFL ML



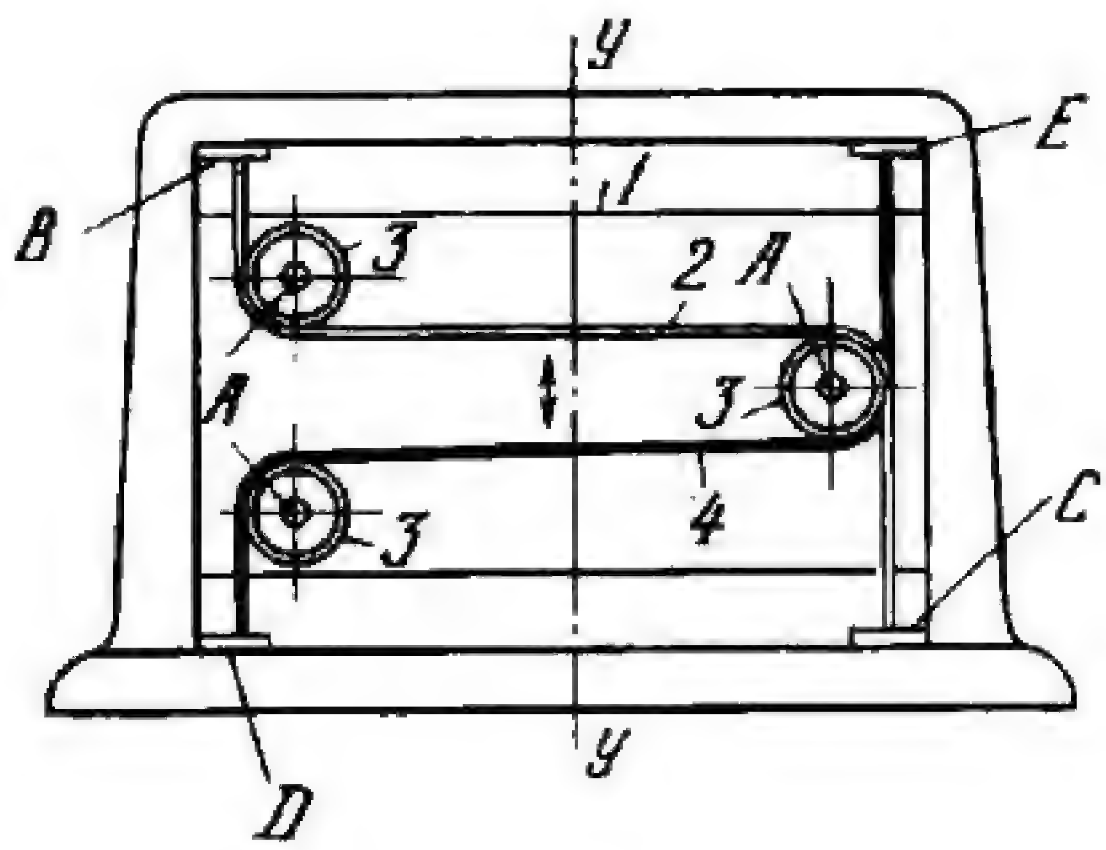
Four identical pulleys *3* rotate about symmetrically located fixed axes *A*. Flexible link (cable) *2* runs over pulleys *3*. Straightedge *1*, attached at points *B* to the flexible link, travels along axis *y-y* with translational motion so that its edges remain parallel to axis *x-x*.

3546	**DOUBLE PARALLEL RULING STRAIGHTEDGE MECHANISM**	CFL ML



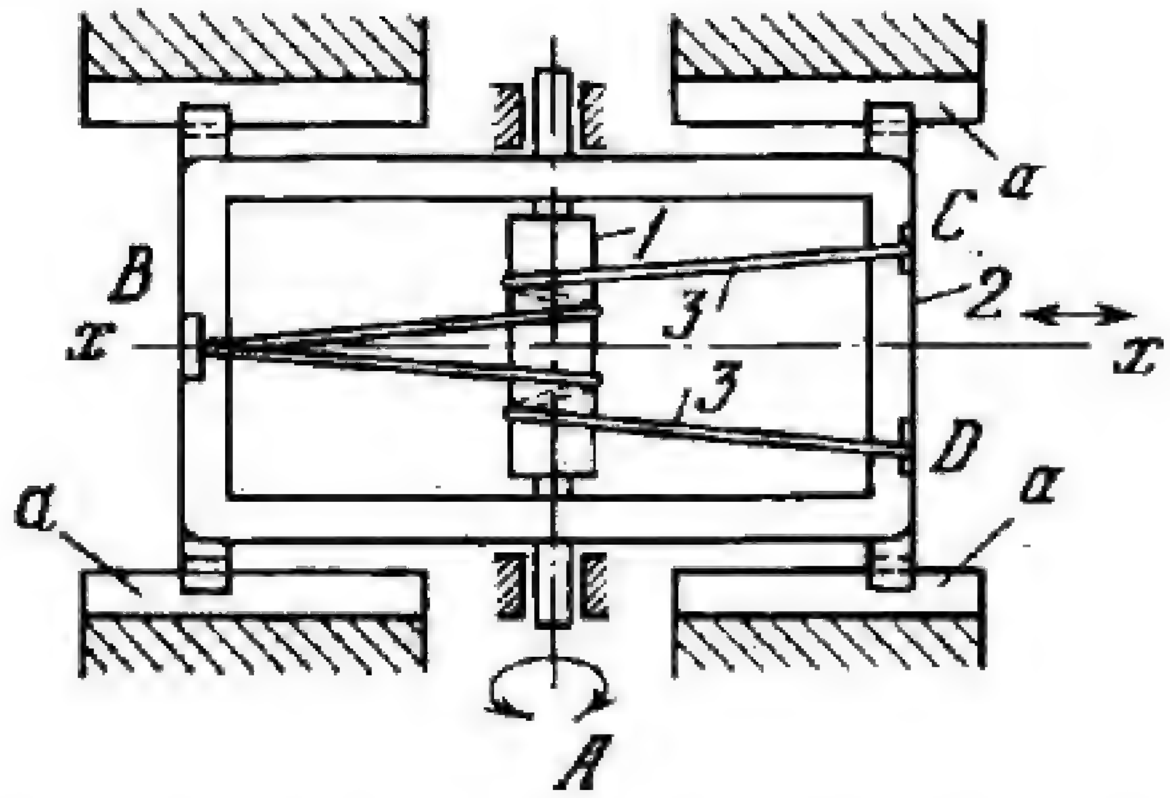
Six identical pulleys *4* rotate about symmetrically located fixed axes A. Flexible link *3* runs over pulleys *4*. Two parallel straightedges *1* and *2* are attached at points K to link *3*. When straightedge *1* travels with translational motion downwards, straightedge *2* travels with translational motion upwards, and their edges remain parallel to axis x-x.

3547	**TRANSLATIONAL RAISING MECHANISM FOR A DRAWING BOARD**	CFL ML



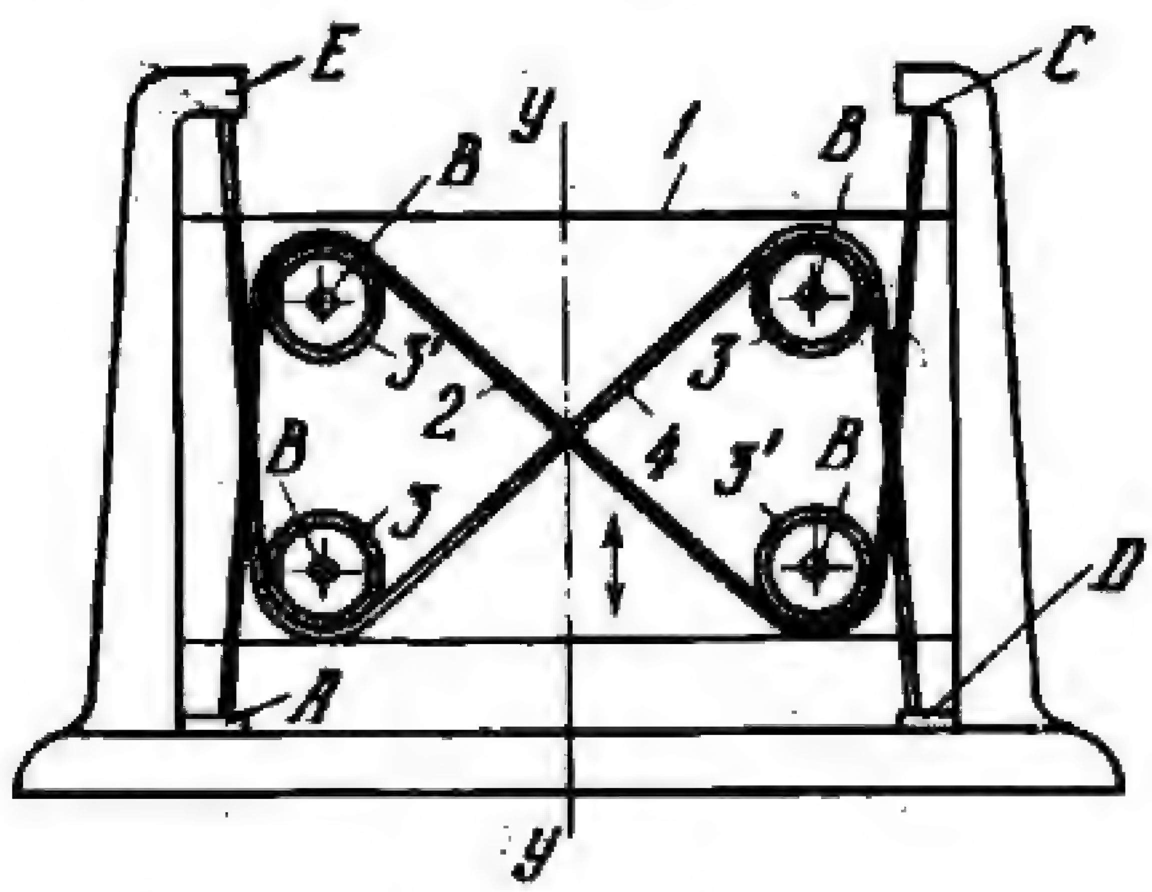
Three identical pulleys *3* rotate about axes A of board *1*. Flexible link *2* runs over the upper left and the right pulleys *3*, and is attached at points B and C to the base. Flexible link *4* runs over the lower left and the right pulleys *3*, and is attached at points E and D to the base. Board *1* can be raised or lowered with translational motion along axis y-y.

3548	FLEXIBLE-LINK MECHANISM FOR TRANSLATIONAL MOTION	CFL ML



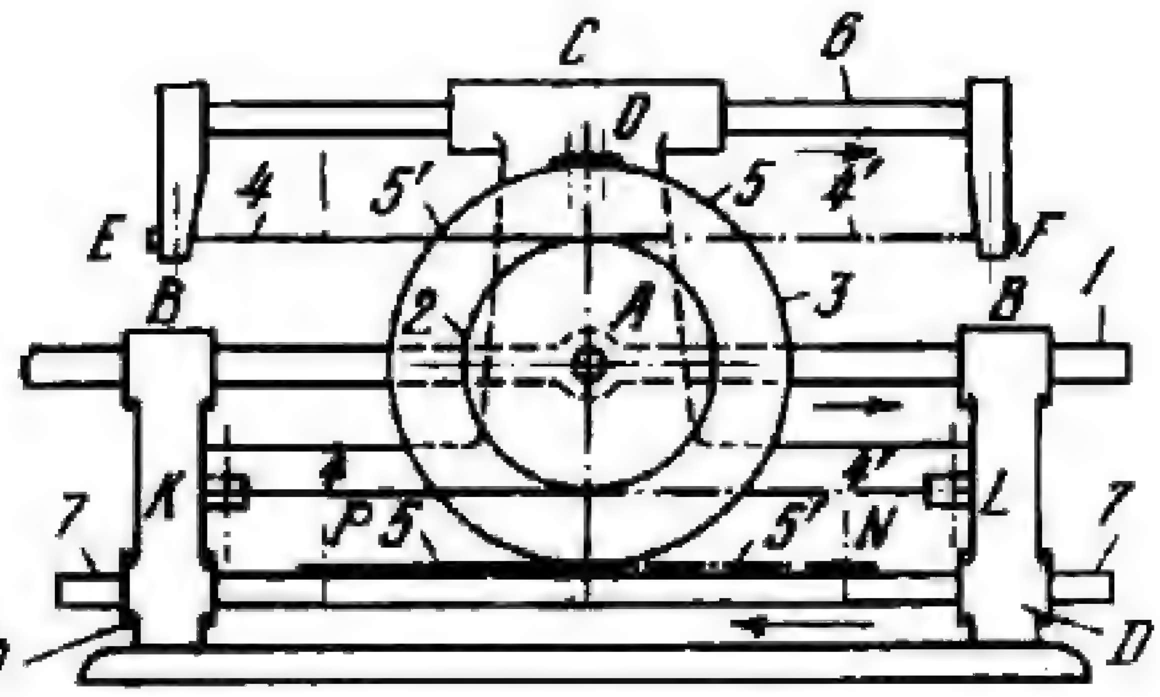
Drum *1* rotates about fixed axis *A*. Flexible links *3* run 360° around the drum and are attached at points *B*, *C* and *D* to slide *2* which has reciprocal translational motion along guides *a* (along axis *x*-*x*).

3549	TRANSLATIONAL RAISING MECHANISM FOR A DRAWING BOARD	CFL ML



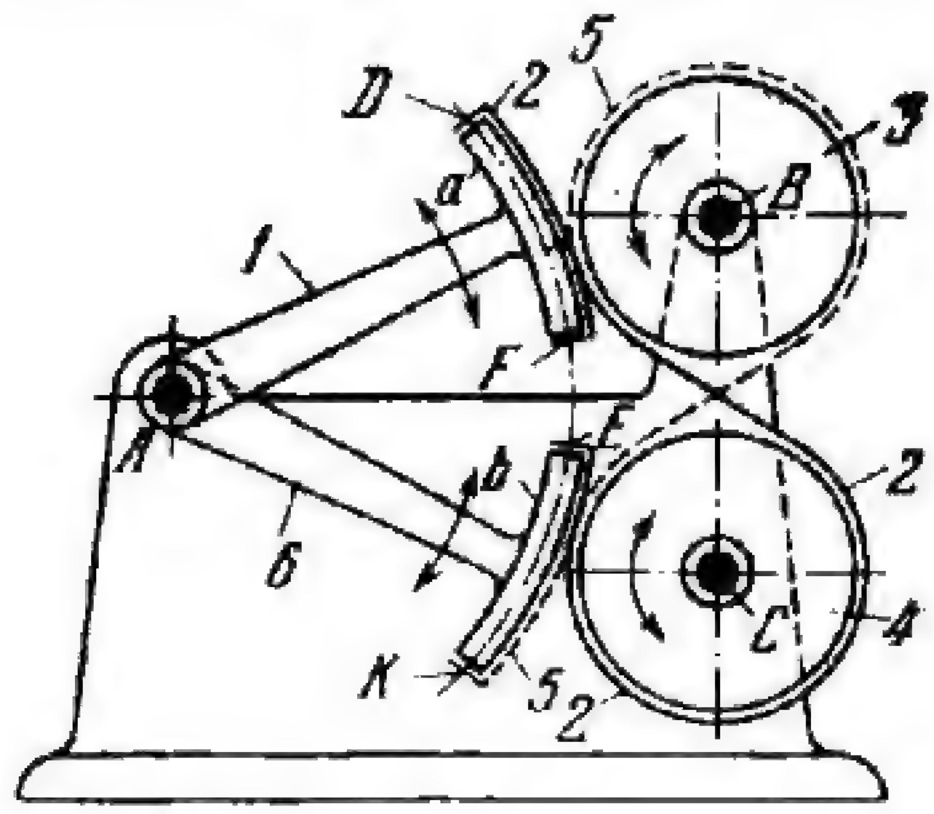
Two pairs of identical pulleys *3* and *3'* rotate about symmetrically located axes *B* of board *1*. Flexible link *4* runs over pulleys *3*, and is attached at points *E* and *D* to the base. Flexible link *2* runs over pulleys *3'*, and is attached at points *A* and *C* to the base. Board *1* can be raised or lowered with translational motion along axis *y*-*y*.

3550	FLEXIBLE-LINK TWO SLIDE DRIVE MECHANISM	CFL ML



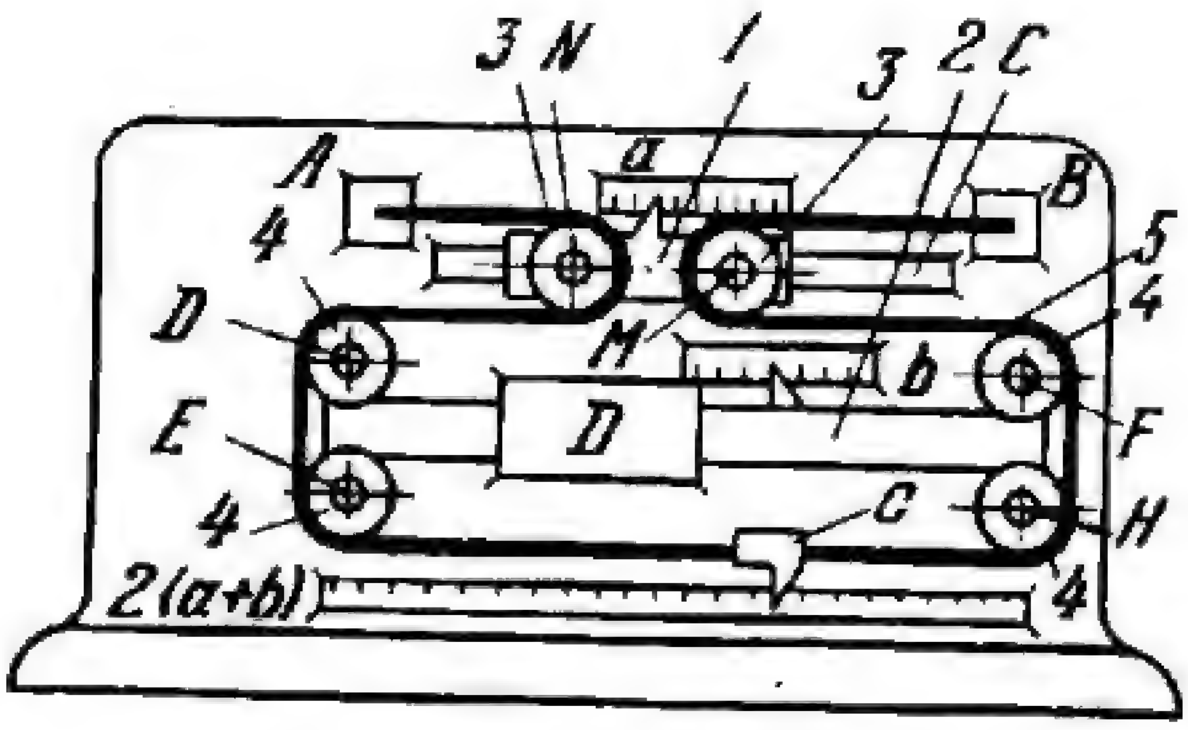
Slides *1*, *6* and *7* reciprocate in fixed guides *B-B*, *C* and *D-D*. Connected by turning pair *A* to slide *1* are two rigidly attached double pulleys *2* and *3*. Flexible links *4* and *4'* run over pulley *2*, and are attached at points *E* and *F* to slide *6* and at points *K* and *L* to the base. Flexible links *5* and *5'* run over pulley *3*, and are attached at points *P* and *N* to slide *7* and at point *O* to pulley *3*. When slide *1* reciprocates, slides *6* and *7* also reciprocate but at different speeds which are proportional to the radii of pulleys *2* and *3*.

3551	FLEXIBLE-LINK DOUBLE PULLEY DRIVE MECHANISM	CFL ML



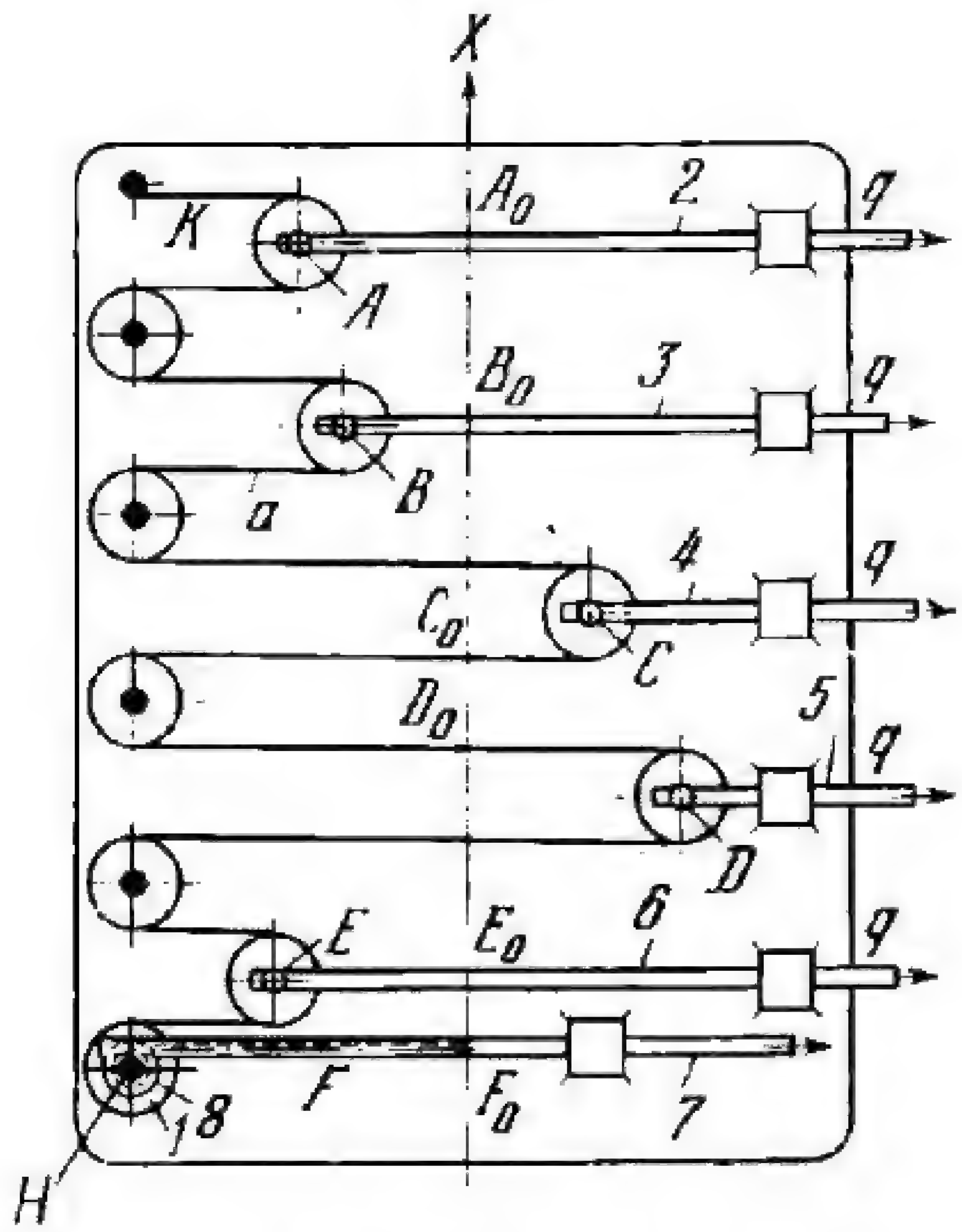
Arms *1* and *6* turn about fixed axis *A* and have identical rim segments *a* and *b*. Two identical pulleys *3* and *4* rotate about fixed axes *B* and *C*. Flexible link *2*, shown by a continuous line, is attached with one end at point *D* to segment *a*, runs over pulley *4* and is attached with its other end at point *E* to segment *b*. Flexible link *5*, shown by a dash line, is attached with one end at point *F* to segment *a*, runs over pulley *3* and is attached with its other end at point *K* to segment *b*. When link *1* oscillates, pulleys *3* and *4* oscillate in opposite directions about axes *B* and *C*.

3552	FLEXIBLE-LINK ADDING MECHANISM	CFL MO



Slide *1* can be moved in either direction along fixed guide *C* and carries two identical pulleys *3* which rotate about axes *N* and *M* of the slide. Slide *2* can be moved in either direction in fixed guide *D* and carries four identical pulleys *4* which rotate about axes *D*, *E*, *H* and *F* of the slide. Flexible link *5*, designed as a steel band, is attached to the base at points *A* and *B*, and runs over pulleys *3* and *4*. One addend *a* is entered by moving slide *1* and the other addend *b* is entered by moving slide *2*. The sum $2(a+b)$ is indicated by index *c* which is attached to flexible link *5*.

3553	FLEXIBLE-LINK MECHANISM FOR ADDING PARALLEL VECTORS	CFL MO

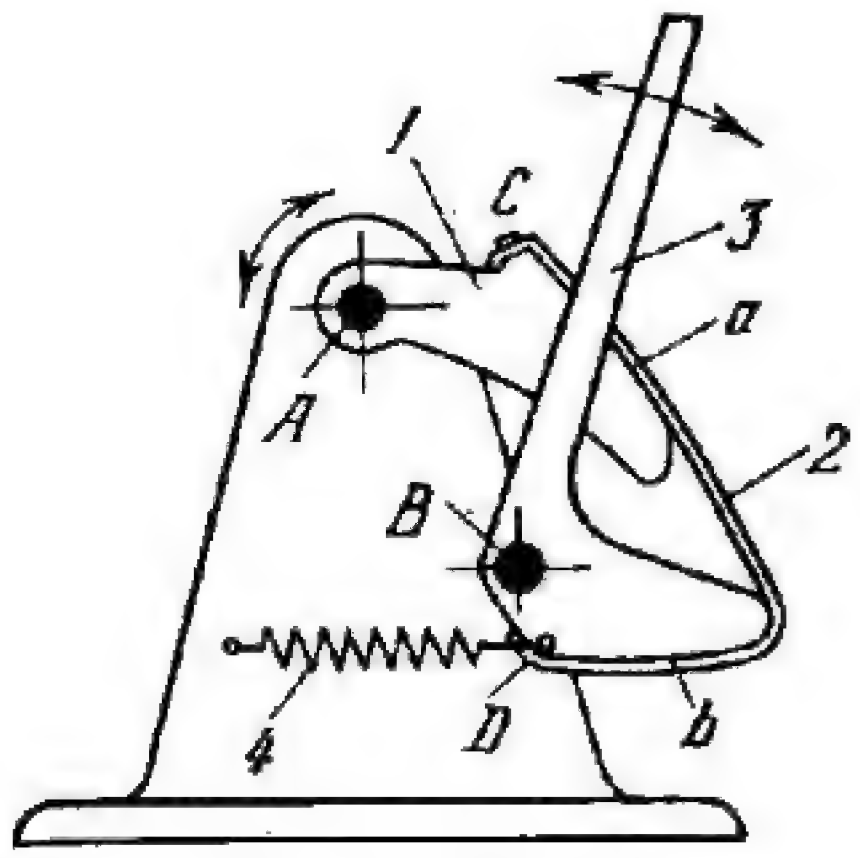


One end of flexible link a, connecting a system of pulleys rotating about moving and fixed axes, is attached at point K to the base. The other end of link a is wound on drum 8 which is rigidly attached to pinion 1 and rotates about fixed axis H. Pinion 1 meshes with gear rack 7. Rules 2, 3, 4, 5 and 6, connected by turning pairs A, B, C, D and E to the movable pulleys, are held in definite positions by applied forces q. If the movable pulleys are displaced from their initial positions A_0, B_0, C_0, D_0 and E_0 to the positions A, B, C, D and E, the displacement z of rule 7 equals the sum of the displacements of rules 2, 3, 4, 5 and 6, i.e.

$$z=\sum_{2}^{6} z_i.$$

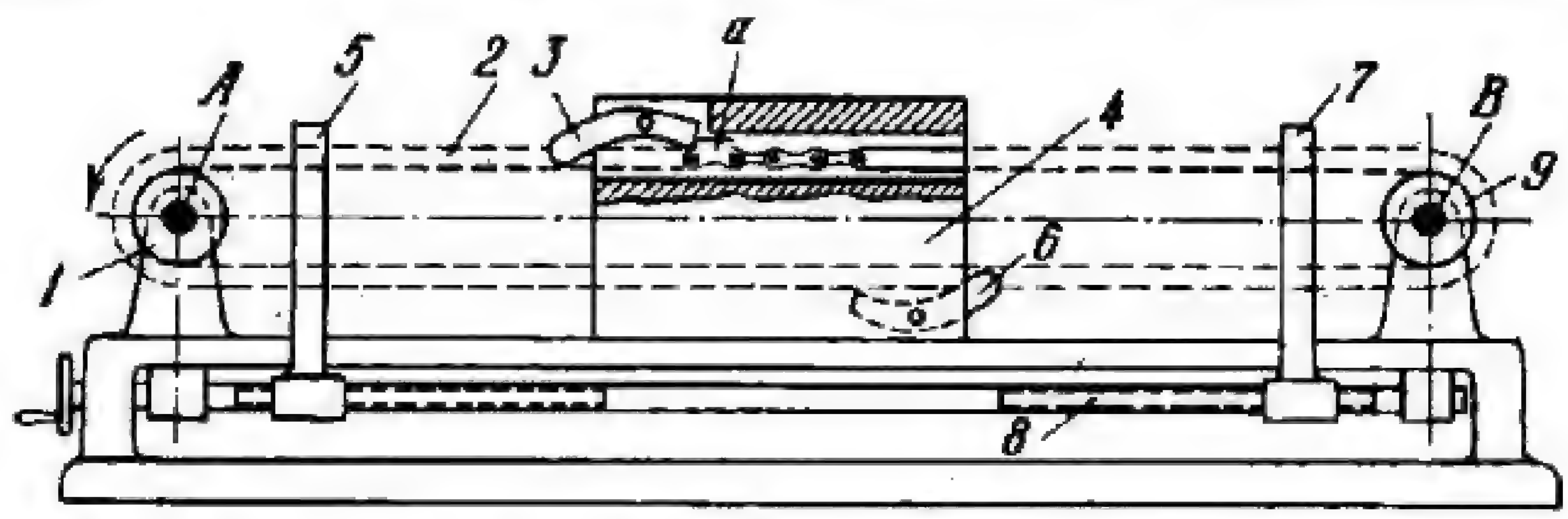
3. SWITCHING, ENGAGING AND DISENGAGING MECHANISMS (3554, 3555 and 3556)

3554	FLEXIBLE-LINK SWITCHING MECHANISM	CFL SE



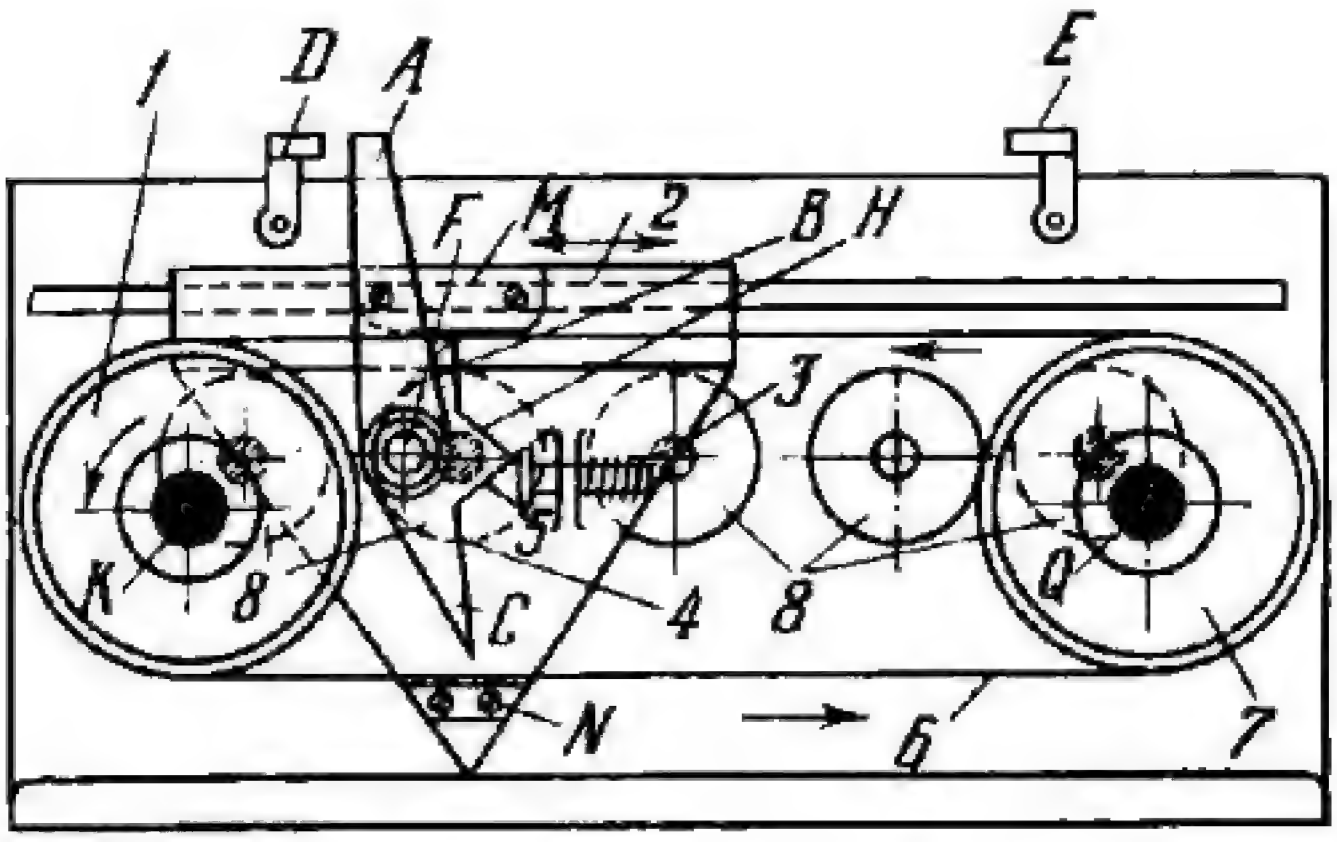
Link *1* turns about fixed axis *A*. Switching lever *3* turns about fixed axis *B*. Link *1* and lever *3* have profiled cam surfaces *a* and *b*. Steel band *2* runs over surfaces *a* and *b* and is attached at its ends *C* and *D* to link *1* and lever *3*. When lever *3* is turned about axis *B*, link *1* turns about axis *A*. Lever *3* is returned to its initial position by spring *4*.

3555	TRACHTENBERG FLEXIBLE-LINK SWITCHING MECHANISM	CFL SE



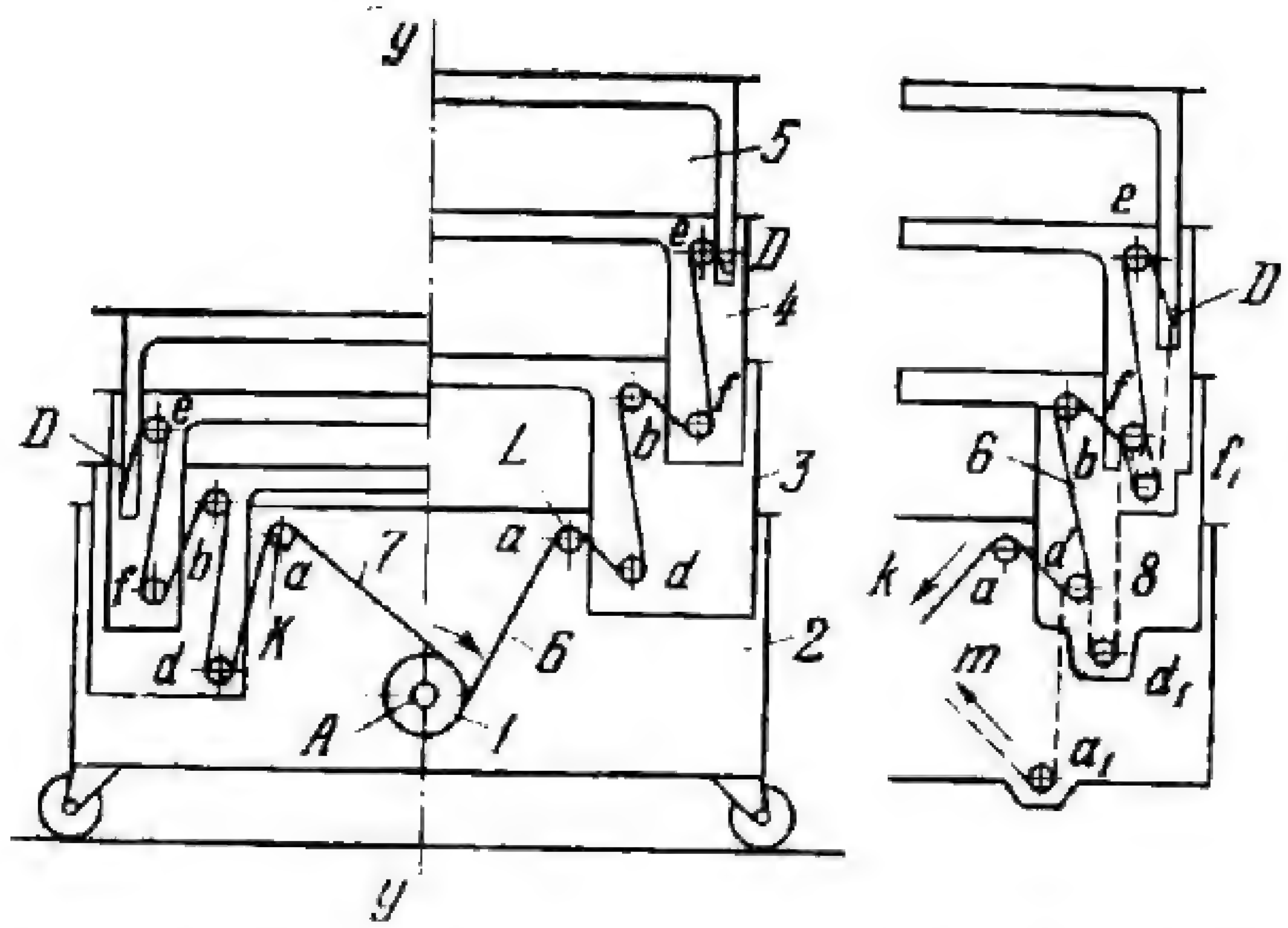
Identical chain sprockets *1* and *9* rotate counterclockwise about fixed axes *A* and *B*. Chain *2* runs over sprockets *1* and *9*. Motion is transmitted to chain *2* by sprocket *1* so that the top strand travels to the left. Link *a* of the chain has a projection. As the chain moves, its link *a* engages upper latch *3*, hinged to slide *4* and traversing it to the left until the arm of latch *3* runs against stop *5* and the latch is disengaged from link *a* and slide *4* stops. When chain link *a* reaches lower latch *6*, also hinged to slide *4*, the latter is traversed in the reverse direction until the arm of the latch runs against stop *7* which disengages the latch so that slide *4* stops again. Screw *8* has right- and left-hand threads and is connected by screw pairs to stops *5* and *7*. Screw *8* is used to adjust stops *5* and *7* which limit the travel of slide *4*.

3556	FLEXIBLE-LINK SWITCHING MECHANISM FOR RECIPROCATING MOTION	CFL SE



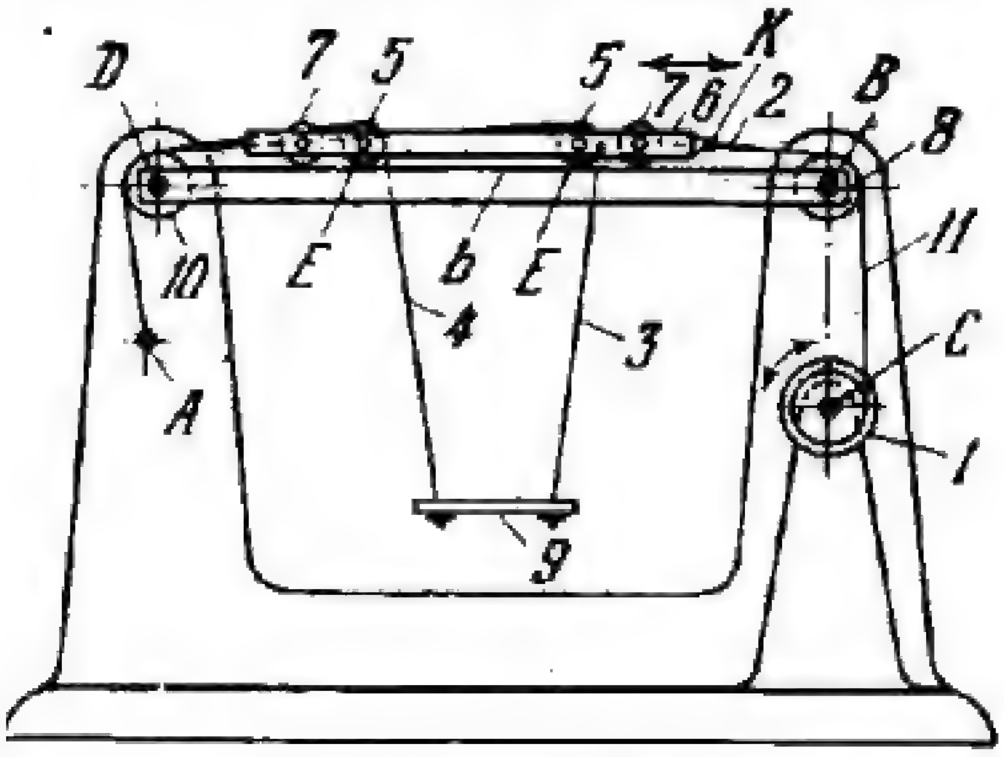
Flexible link (steel belt) *6* runs over pulleys *1* and *7* which rotate about fixed axes *K* and *Q*. Slide *2* is reciprocated by alternately engaging and disengaging opposite sides of the steel belt which is gripped between prong *B* or *C* of four-arm tumbler lever *4* and lug *M* or *N* of the slide. Lever *4* turns about axis *F* of slide *2*. As shown, belt *6* is gripped between prong *B* of lever *4* and lug *M* of slide *2* which travels in the same direction (to the left) as the top side of the belt. At the extreme left position of slide *2*, arm *A* of lever *4* engages fixed stop *D*, turning the lever clockwise so that prong *B* is disengaged from belt *6* whose bottom side is gripped between prong *C* of lever *4* and lug *N* on the slide. At this, slide *2* travels to the right until arm *A* engages fixed stop *E*, reversing the slide again. Plunger *5*, actuated by spring *3*, has a conical head which contacts either the upper or lower bevel of prong *H* of lever *4*, locking the lever in either of its two positions. Slide *2* travels along rollers *8* to reduce friction in its reciprocating motion.

3557	FLEXIBLE-LINK PLATFORM LIFTING MECHANISM FOR A LIFT TRUCK	CFL MH



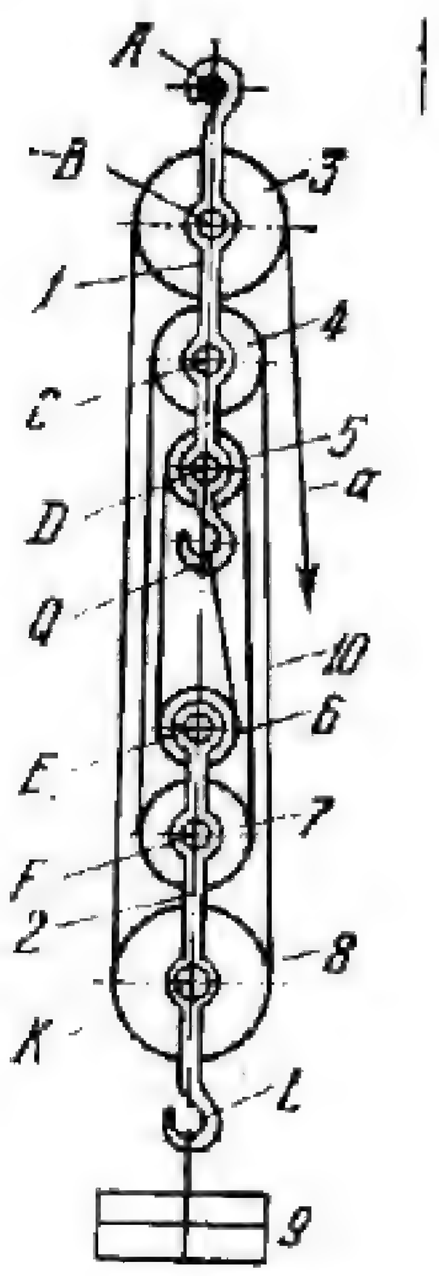
Lift truck *2* has platforms *3*, *4* and *5* which are shown in the raised position to the right of axis *y-y*, and in the lowered position to the left of this axis. The platforms can be raised and lowered with translational motion along axis *y-y*. The platforms are raised by flexible links *6* and *7*, attached to drive pulley *1* which rotates about axis *A* of truck *2*. Flexible links *6* and *7* run over identical pulleys *a*, *d*, *b*, *f* and *e*, and are attached to the top platform at points *D*. Pulleys *a* rotate about axes *K* and *L* of the truck. When pulley *1* rotates clockwise, the platforms are raised along axis *y-y*. Here flexible link *6* moves in the direction of arrow *k* as shown in the right-hand drawing. The platforms are lowered by gravity and the action of flexible link *8* (shown at the right by dash lines) which runs over pulleys a_1, d, d_1, f and f_1, and is attached at point D. Link *8* moves in the direction of arrow *m*, being wound on a separate pulley which rotates counterclockwise.

3558	FLEXIBLE-LINK TRANSVERSING MECHANISM FOR AN UNDERSLUNG PLATFORM	CFL MH



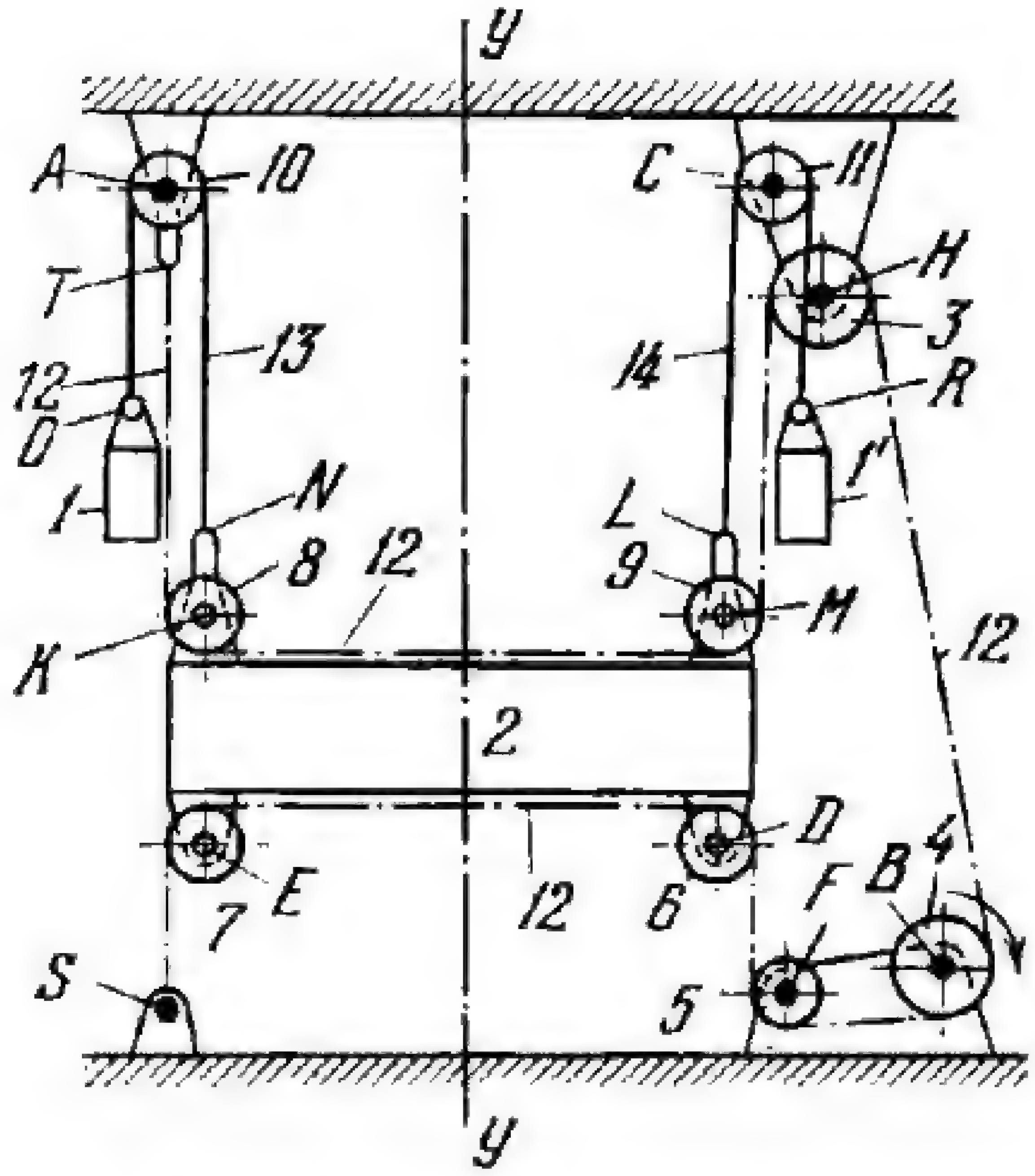
Drum 1 rotates about fixed axis C. Identical pulleys 8 and 10 rotate about fixed axes B and D. Truck 6 travels on rollers 7 along fixed guide b. Pulleys 5 rotate about axes E of truck 6. One end of flexible link 11 is attached at point K to truck 6, and the other end to drum 1. Movable platform 9 is suspended on ropes 3 and 4, which run over pulleys 5 and pulley 10. Ropes 3 and 4 are attached at point A to the base. When drum 1 rotates clockwise, platform 9 has a complex motion, rising and moving to the right. When drum 1 is rotated counterclockwise, platform 9 is lowered and moves to the left.

3559	SIX-PULLEY BLOCK-AND-TACKLE HOISTING MECHANISM	CFL MH



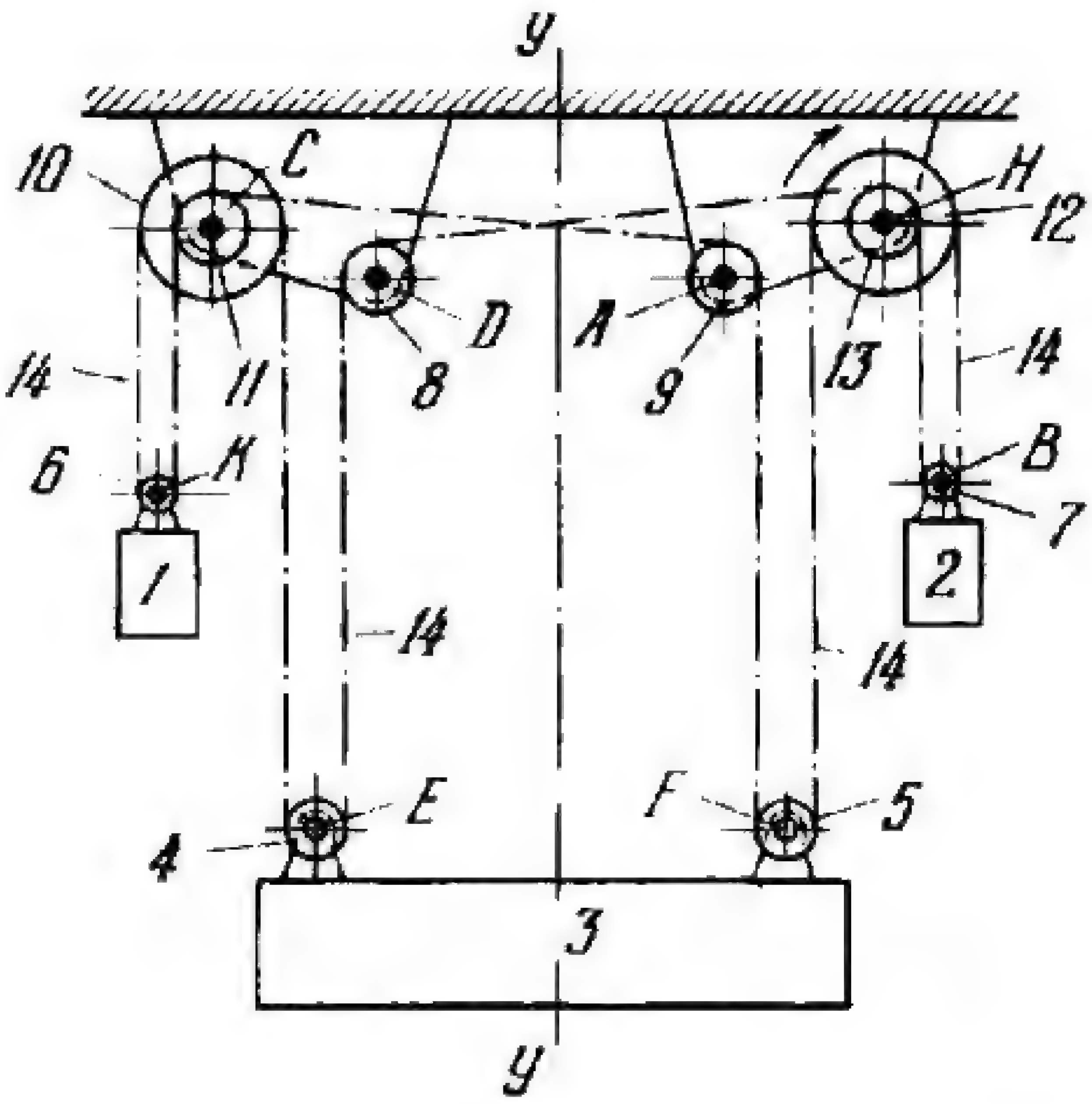
Block 1, with three pulleys 3, 4 and 5 rotating about axes B, C and D, is hung at fixed point A. Block 2, with three pulleys 8, 7 and 6 of sizes equal respectively to those of pulleys 3, 4 and 5, and rotating about axes K, F and E, carries hook L from which load 9 is suspended. Flexible link (rope) 10 has one end attached to hook Q of block 1 and runs consecutively over pulleys 6, 5, 7, 4, 8 and 3. When the other end a of link 10 is displaced a distance s, load 9 is displaced the distance $S = \frac{s}{6}$. Thus the mechanical advantage equals 6.

3560	FLEXIBLE-LINK PLATFORM RAISING MECHANISM	CFL MH



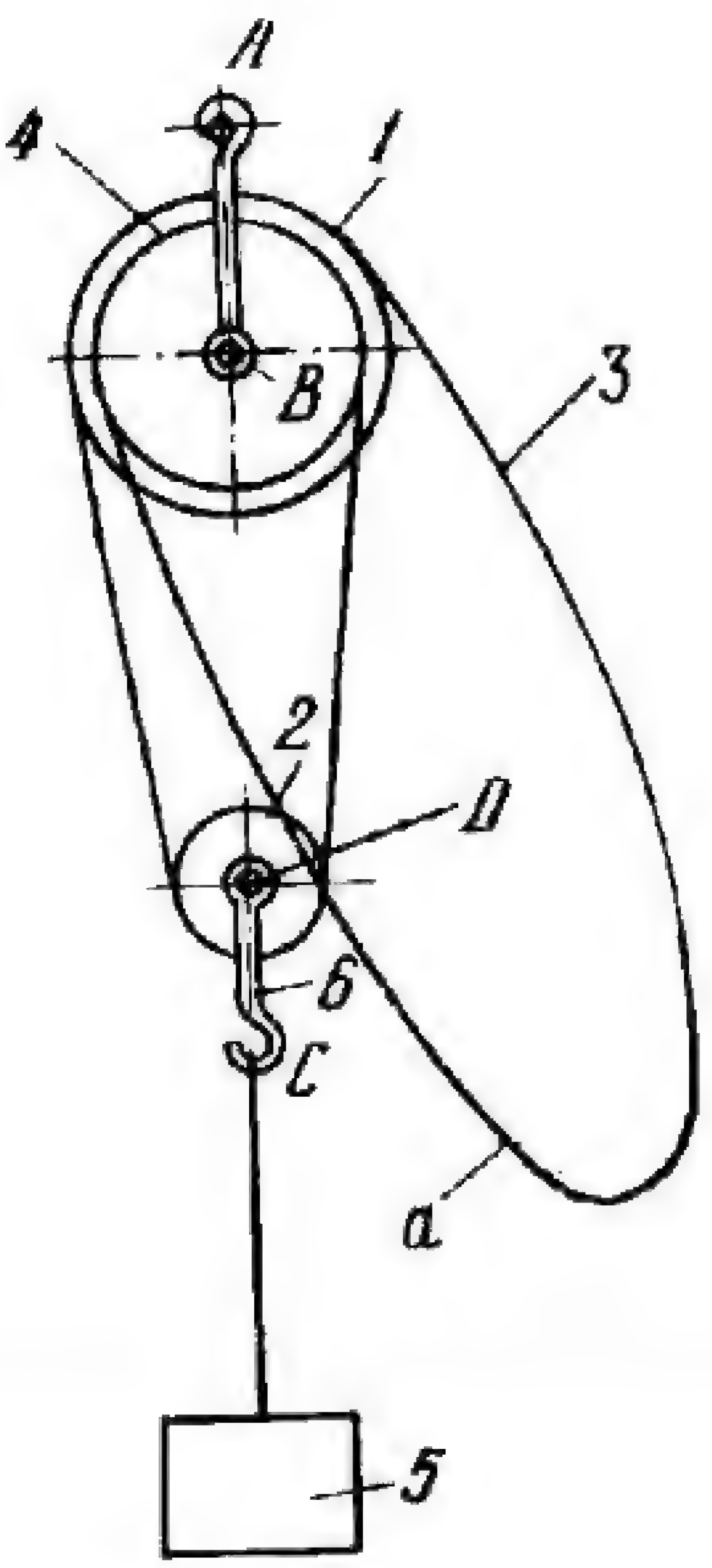
Four identical pulleys *6*, *7*, *8* and *9* rotate about axes *D*, *E*, *K* and *M* of platform *2* which is to be raised and lowered. Pulleys *3*, *4* and *5* rotate about fixed axes *H*, *B* and *F*. Two identical pulleys *10* and *11* rotate about fixed axes *A* and *C*. Flexible link *12*, shown by dot-and-dash lines, runs over pulleys *7*, *6*, *5*, *4*, *3*, *9* and *8*, and is attached to the base at points *S* and *T*. Flexible links *13* and *14* run over pulleys *10* and *11*, and are attached to platform *2* at points *N* and *L*, and to counterbalancing weights *1* and *1'* at points *O* and *R*. Platform *2* is raised or lowered by rotating drive pulley *4* about axis *B*: clockwise to raise and counterclockwise to lower the platform which has translational motion along axis *y-y*.

3561	ENDLESS FLEXIBLE-LINK PLATFORM RAISING MECHANISM	CFL MH



Identical pulleys *4* and *5* rotate about axes *E* and *F* of platform *3* which is to be raised and lowered. Identical pulleys *8* and *9* rotate about fixed axes *D* and *A*. Rigidly attached pulleys *10* and *11*, and *12* and *13* rotate about fixed axes *C* and *H*. Identical pulleys *6* and *7* rotate about axes *K* and *B* of counterbalancing weights *1* and *2*. Endless flexible link *14* runs over all the pulleys in the following sequence: *5*, *12*, *7*, *13*, *8*, *4*, *10*, *6*, *11* and *9*. Platform *3* is raised or lowered with translational motion along axis *y-y* by rotating pulley *10* or *12* about axis *C* or *H*.

3562	ENDLESS FLEXIBLE-LINK DIFFERENTIAL HOIST MECHANISM	CFL MH

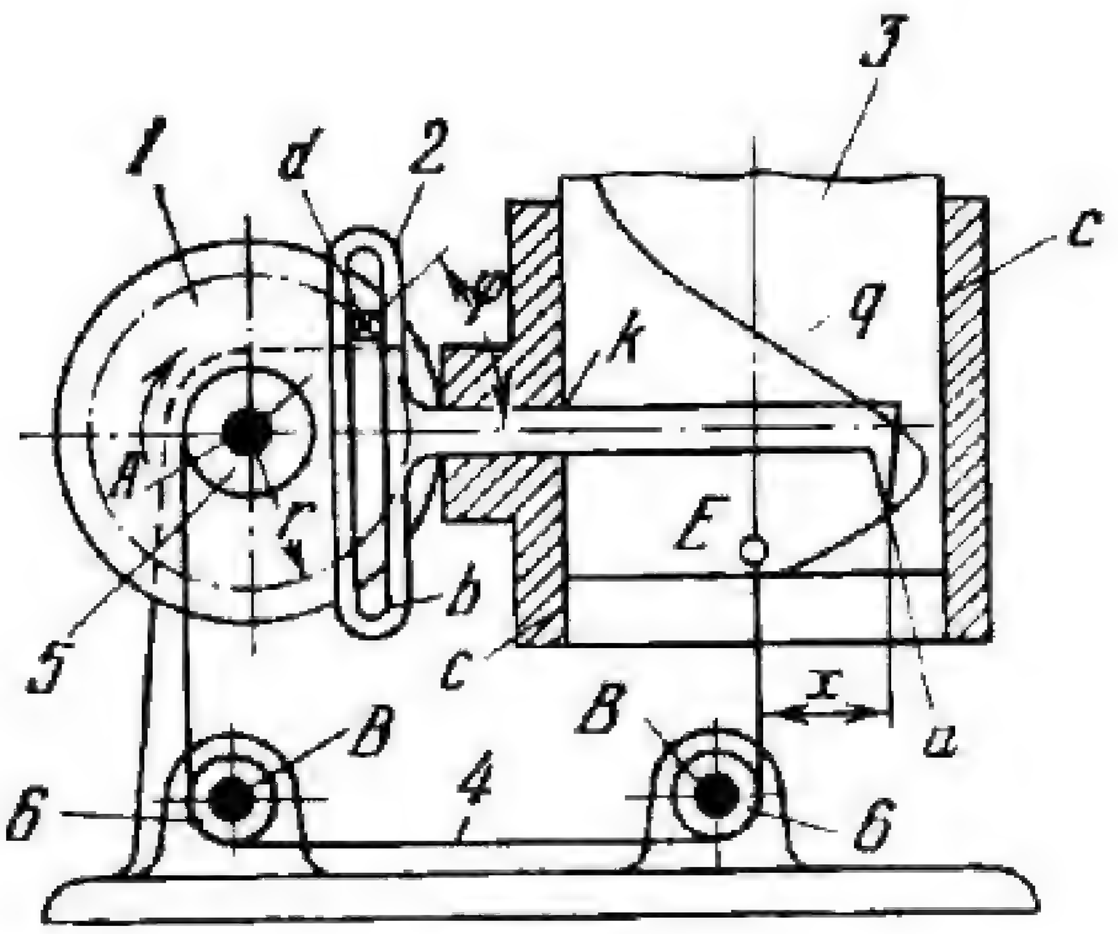


Rigidly attached sheaves *1* and *4* rotate about axis *B* of the block. Sheave *2* rotates about axis *D* of hook *6* on which load *5* hangs at point *C*. Endless flexible link (chain) *3* runs over sheaves *1*, *2* and *4*. Load *5* is hoisted by pulling on the loose loop *a* of the chain in the direction of the arrow. The mechanical advantage is

$$\text{M.A.} = \frac{2d_1}{d_1 - d_4}$$

where d_1 and d_4 are the diameters of sheaves *1* and *4*.

3563	FLEXIBLE-LINK MECHANISM FOR TRACING COSINUSOIDS	CFL Ge

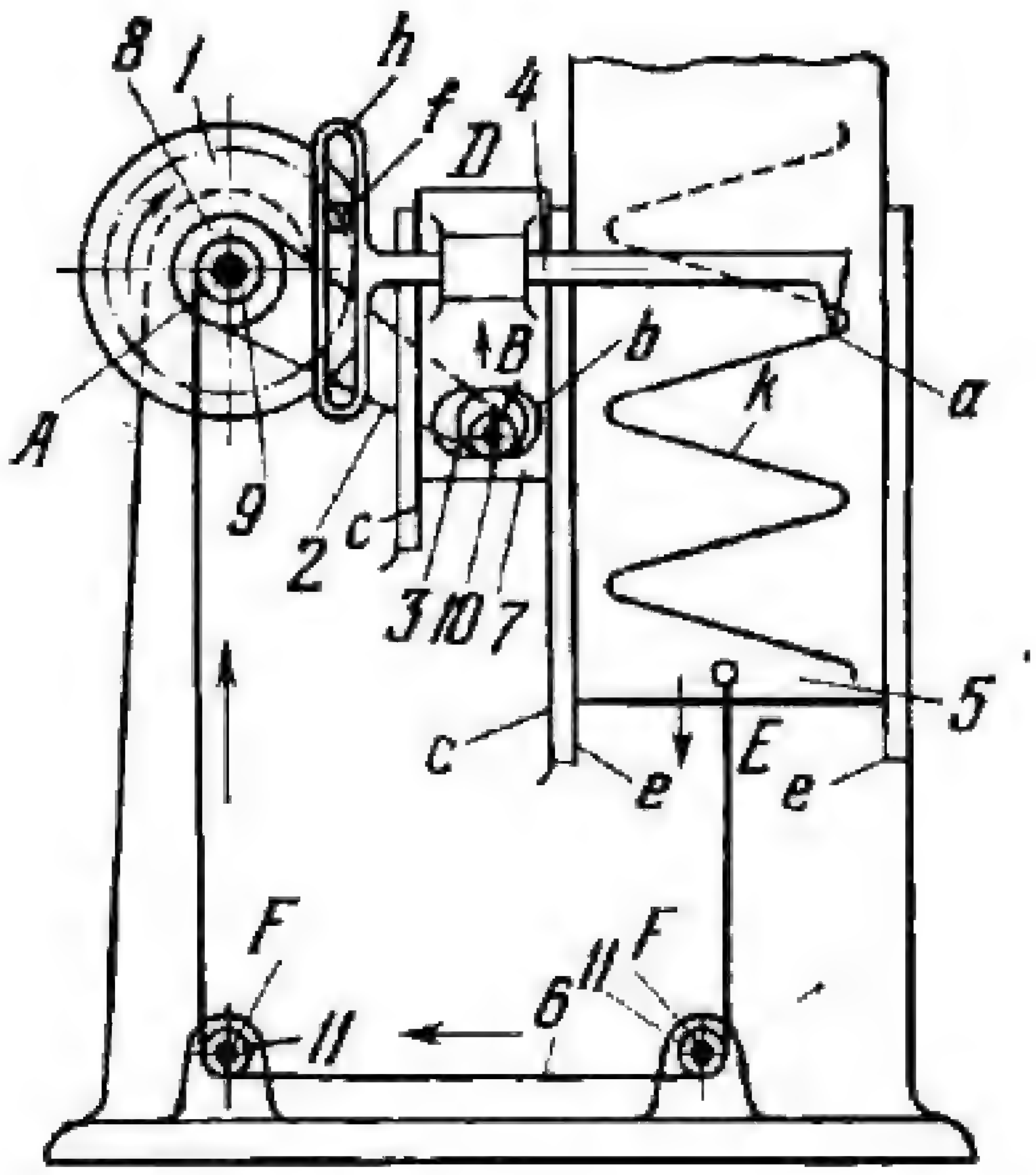


Link *1* rotates about fixed axis *A* and carries pin *d* which slides along straight slot *b* of link *2*. Link *2* reciprocates in fixed guide *k*. Rigidly attached to link *1* is pulley *5* to which one end of flexible link *4* is secured. Link *4* runs over identical pulleys *6* which rotate about fixed axes *B*. The other end of link *4* is attached at point *E* to slide *3* which reciprocates along fixed guides *c-c*. When link *1* rotates, point *a* of slotted link *2* describes cosinusoid *q* on slide *3*. The equation of the cosinusoid is

$$x = r \cos \varphi$$

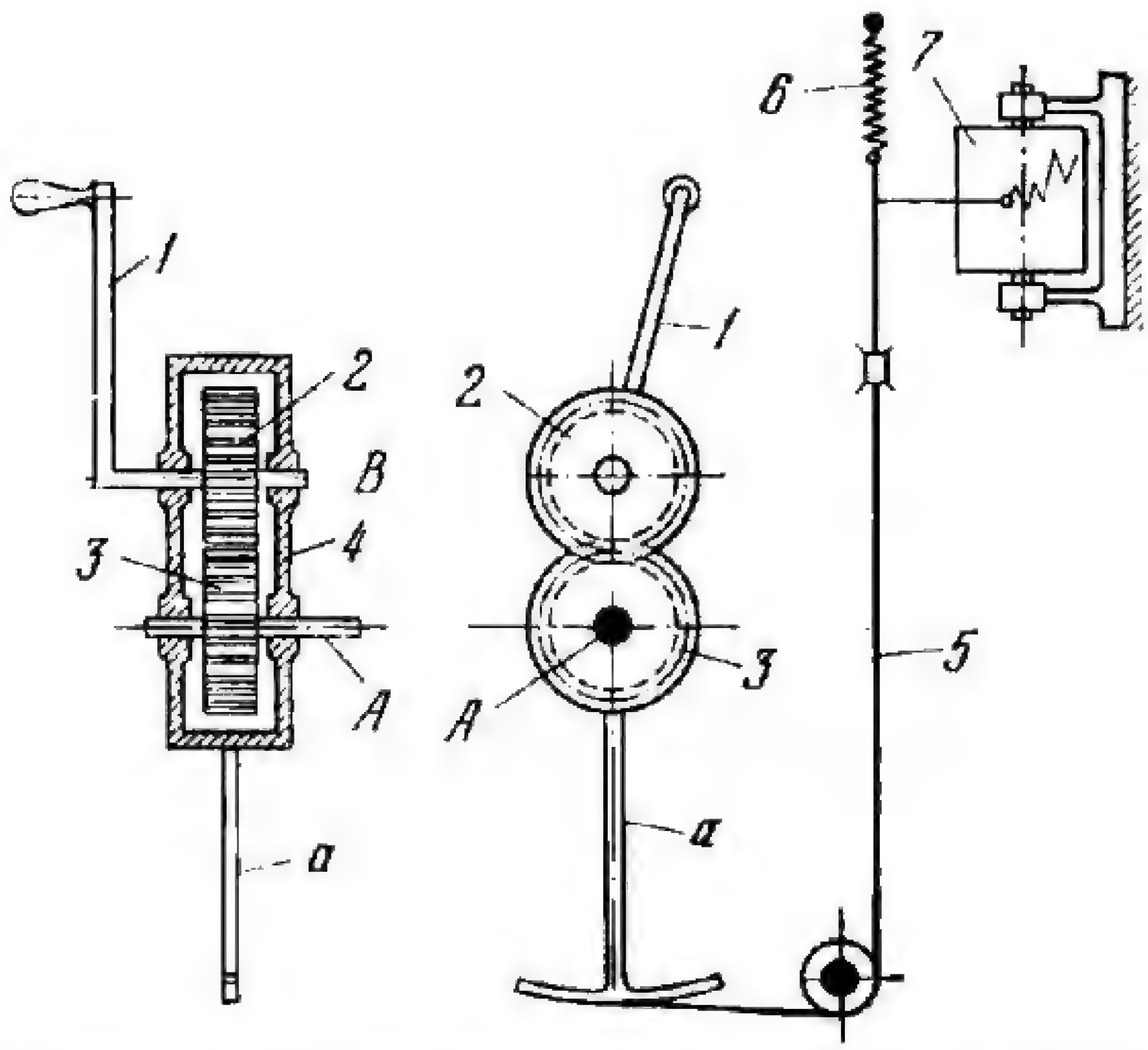
where *r* is the distance from the centre of pin *d* to axis *A* and φ is the angle of rotation of link *1*.

3564	FLEXIBLE-LINK MECHANISM FOR TRACING SINUSOID-TYPE CURVES	CFL Ge



Link *1* rotates about fixed axis *A*, carries pin *f* and is rigidly attached to pulleys *8* and *9*. Flexible link *2* runs over pulley *8* and pulley *10* which rotates about fixed axis *B* and is rigidly attached to eccentric *3*. Eccentric *3* is confined between horizontal surfaces of yoke *7* which reciprocates along fixed guides *c-c*. Pin *f* of link *1* slides along straight slot *h* of link *4* which reciprocates in guide *D* of yoke *7*. Flexible link *6*, attached to pulley *9*, runs over pulleys *11* which rotate about fixed axes *F*. The other end of link *6* is attached at point *E* to slide *5* which has translational motion along guides *e-e*. When link *1* rotates, motion is transmitted through flexible link *2* to eccentric *3* which makes two revolutions to each revolution of link *1* and reciprocates yoke *7*. At the same time, link *4* is reciprocated horizontally by pin *f*, and slide *5* is transversed downward by flexible link *6*. At this, point *a* of link *4* describes sinusoid-type curve *k* on slide *5* (as shown).

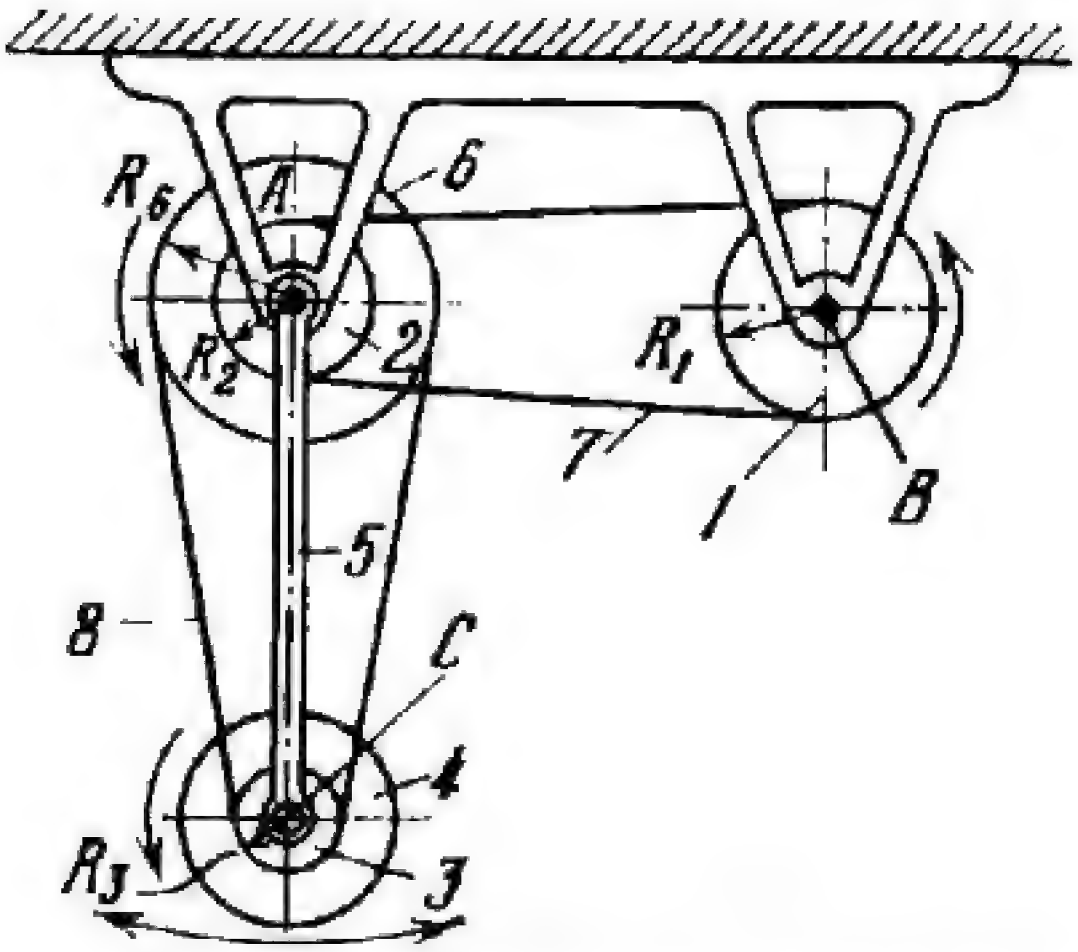
3565	GORYACHKIN FLEXIBLE-LINK DYNAMOMETRIC LEVER MECHANISM	CFL M



Crank handle *1* is rigidly attached to spur gear *2* which rotates about axis *B* of housing *4* and meshes with spur gear *3*. When crank handle *1* is turned, gear *2* rolls around gear *3* which is keyed to a shaft rigidly coupled to the drive shaft of the machine being tested. At this, housing *4* and sector *a*, rigidly attached to the housing, turn about axis *A*, pulling cable *5* which is attached to measuring spring *6*. The tension in spring *6* is registered on rotating drum *7*.

7. DIFFERENTIAL FLEXIBLE-LINK MECHANISMS
(3566 through 3583)

3566	FLEXIBLE-LINK DIFFERENTIAL PENDULUM MECHANISM	CFL DF

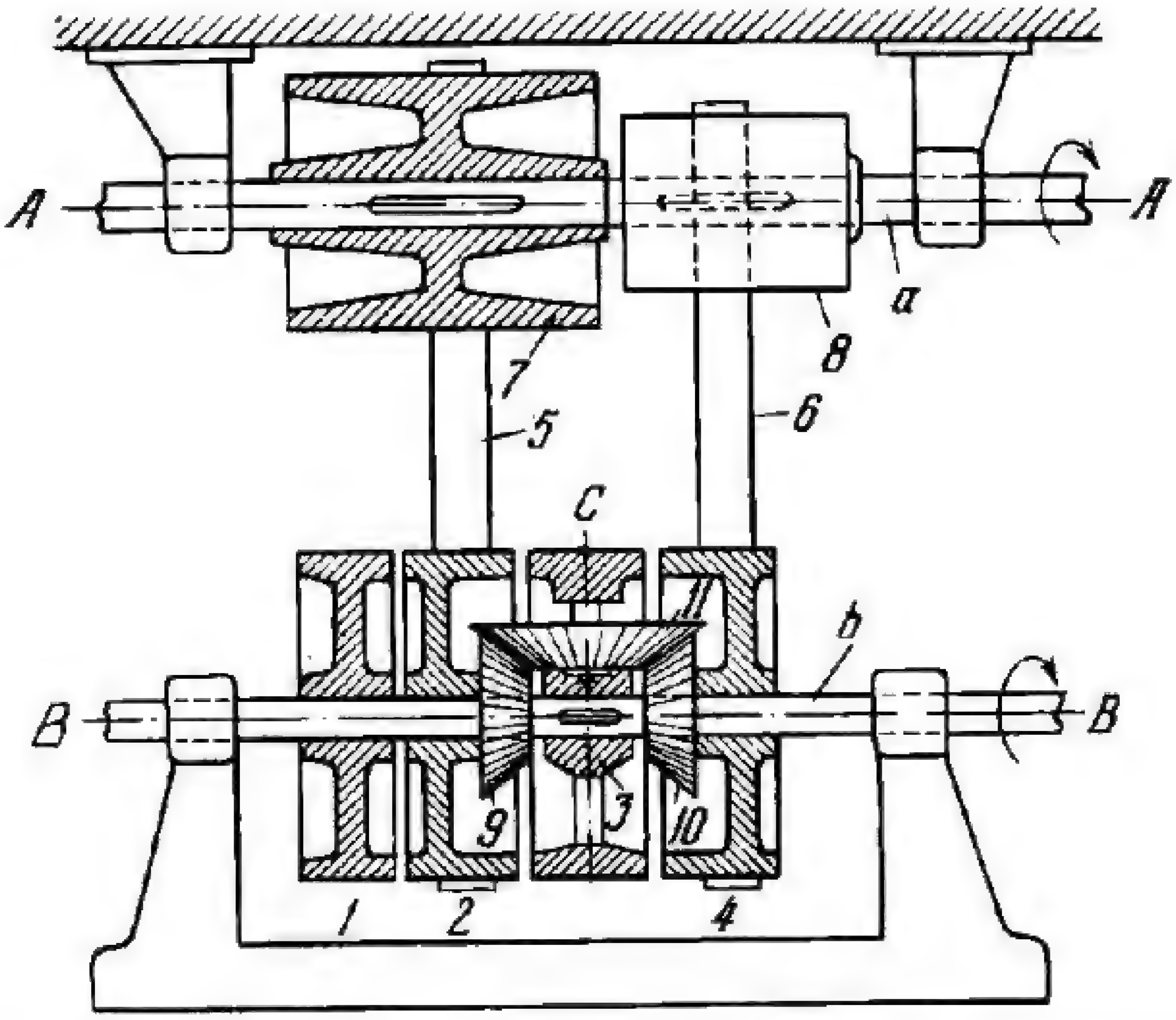


Pulley *1* rotates about fixed axis B. Rigidly attached pulleys *2* and *6* rotate about fixed axis A. Pulley *3* rotates about axis C of pendulum *5* which oscillates about axis A. Disk *4* is keyed to the shaft of pulley *3* and is used to perform a processing operation. Flexible links *7* and *8* run over pulleys *1* and *2*, and *6* and *3*. The angular velocities of pulleys *1* and *3*, and of pendulum *5* are related by the equation

$$\omega_5 = \frac{R_1 R_6 \omega_1 - R_2 R_3 \omega_3}{R_2 (R_6 - R_3)}$$

where ω_1, ω_3, ω_5, R_1, R_2, R_3 and R_6 are the angular velocities and radii of pulleys *1*, *2*, *3* and *6* and pendulum *5*.

3567	FLEXIBLE-LINK DIFFERENTIAL GEARING MECHANISM	CFL DF

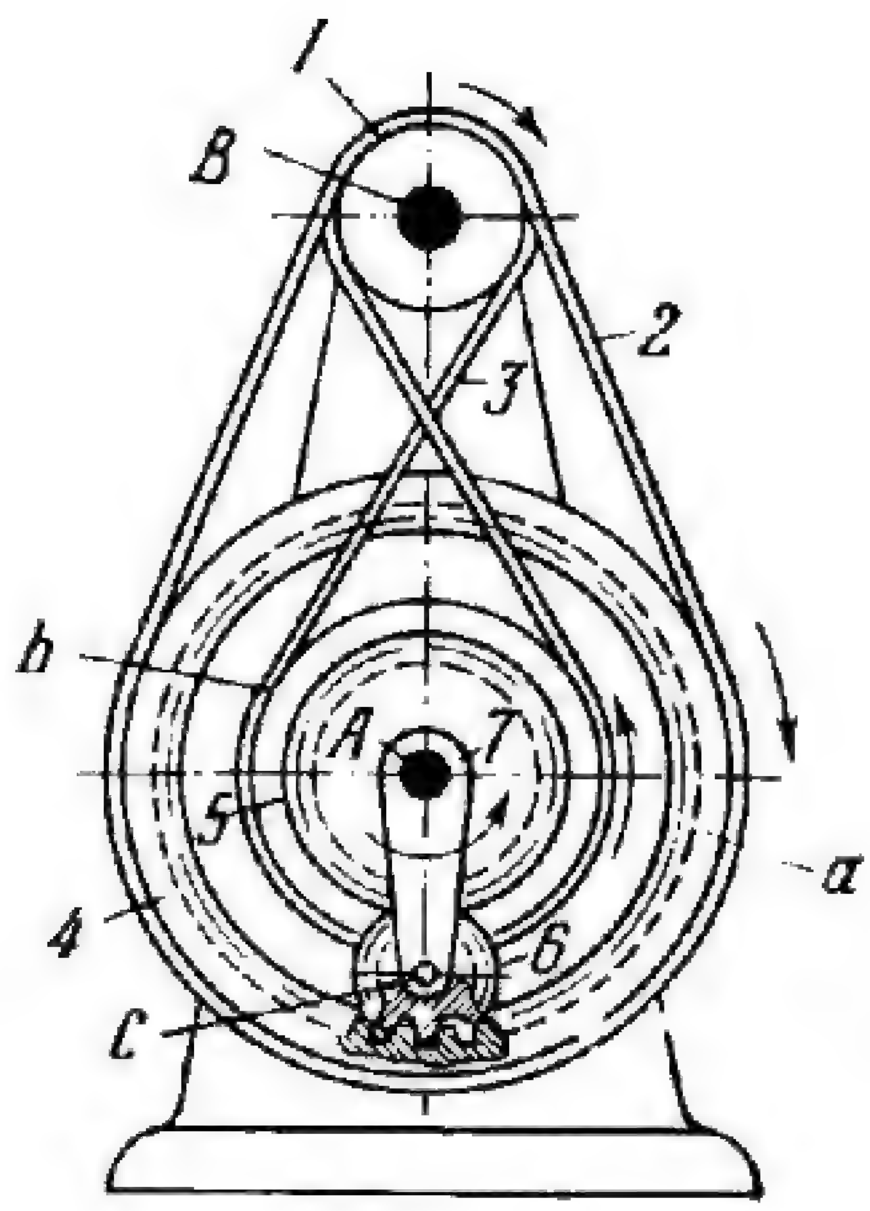


Pulleys 7 and 8 are of different diameters. They are keyed to shaft a and rotate about fixed axis A-A. Belts 5 and 6 transmit rotation to pulleys 2 and 4 which rotate freely on shaft b about fixed axis B-B. Rigidly attached to pulleys 2 and 4 are identical bevel gears 9 and 10 which mesh with planet bevel gear 11. Gear 11 rotates about axis C of pulley 3 which is the carrier of the differential gearing and is keyed to shaft b. The speeds n_a and n_b of shafts a and b (in rpm) are related by the equation

$$n_b = n_a \frac{D_4 D_7 + D_2 D_8}{2 D_2 D_4}$$

where D_2, D_4, D_7 and D_8 are the diameters of pulleys 2, 4, 7 and 8. Pulley 1 rotates freely about shaft b and serves to disengage the drive by shifting belt 5 from pulley 2 to pulley 1.

3568	DIFFERENTIAL GEARING MECHANISM WITH TWO FLEXIBLE LINKS	CFL DF

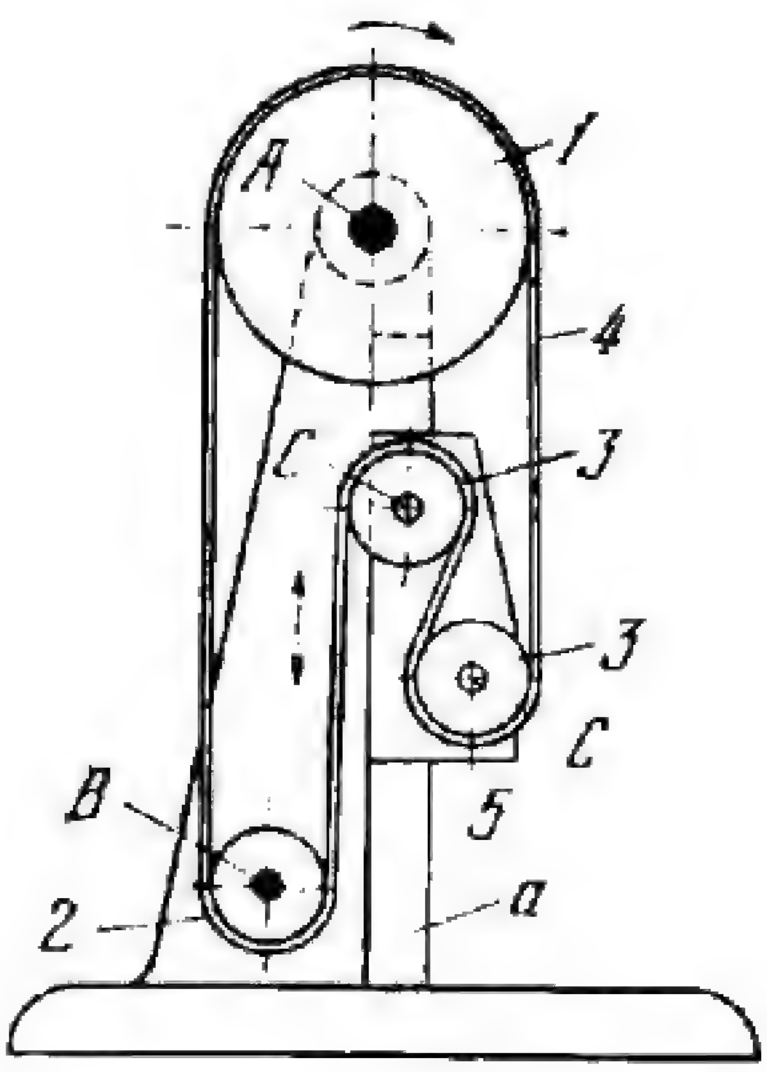


Pulley *1* rotates about fixed axis B and transmits rotation through flexible links *2* and *3* to pulleys a and b. Since link *3* is crossed and link *2* is open, pulleys a and b rotate in opposite directions about fixed axis A. Rigidly attached to pulleys a and b are internal gear *4* and external gear *5* which mesh with planet idler gear *6*. Gear *6* is connected by turning pair C to carrier *7* which rotates about axis A. The speeds n_1 and n_7 of pulley *1* and carrier *7* (in rpm) are related by the equation

$$n_7 = n_1 \frac{R_1}{R_a R_b} \frac{R_b z_4 - R_a z_5}{z_4 + z_5}$$

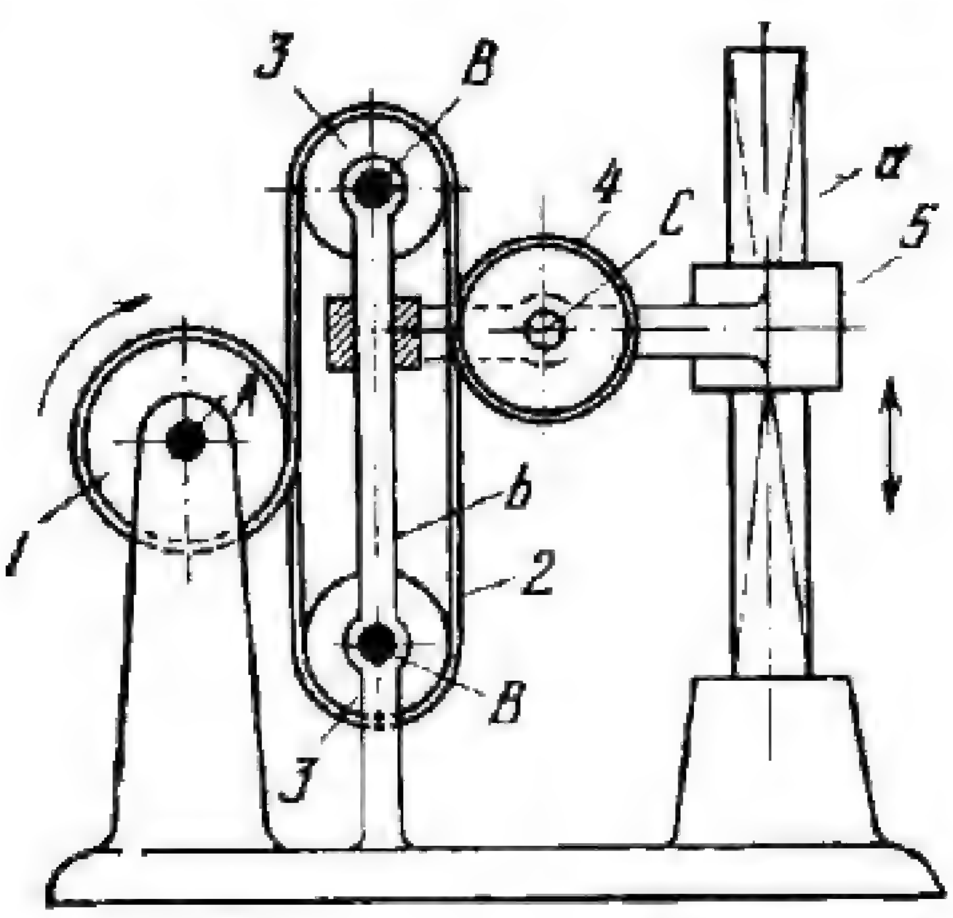
where z_4 and z_5 are the number of teeth of gears *4* and *5*, and R_1, R_a and R_b are the radii of pulleys *1*, a and b.

3569	FLEXIBLE-LINK DIFFERENTIAL MECHANISM WITH TWO MOVABLE PULLEYS	CFL DF



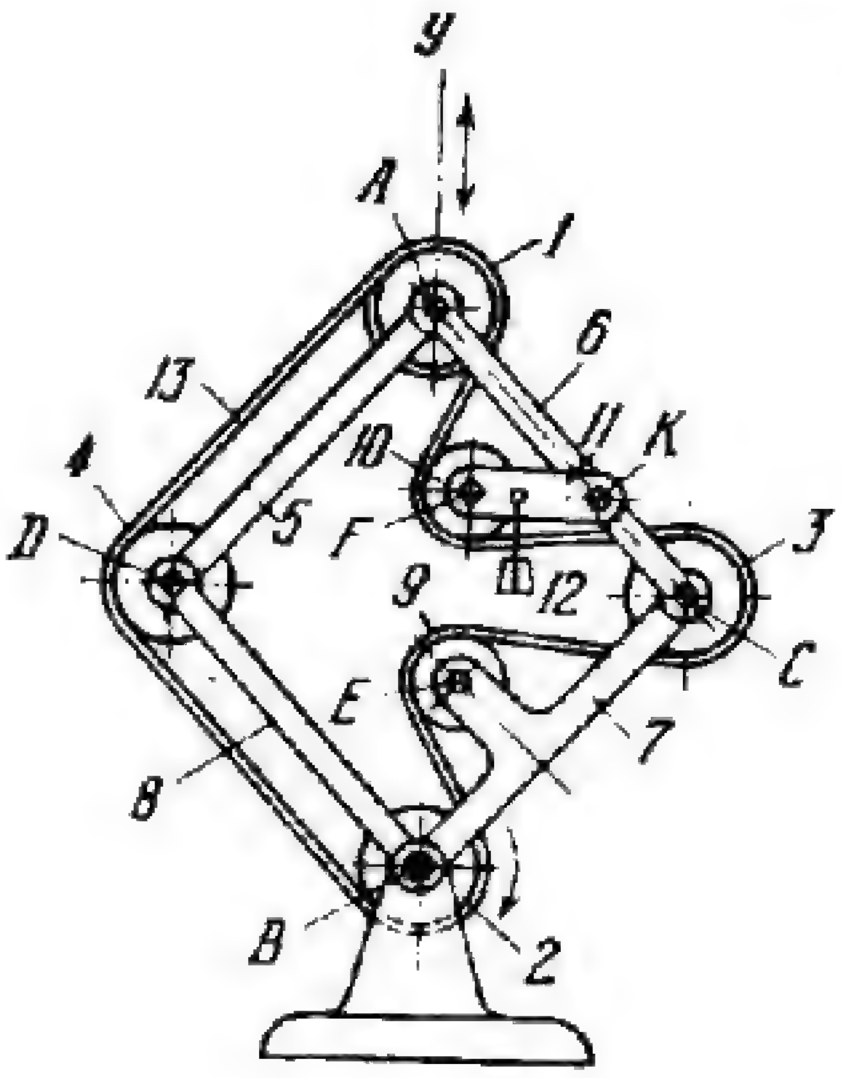
Pulleys *1* and *2* rotate about fixed axes *A* and *B*. Two identical pulleys *3* rotate about axes *C* of slide *5* which reciprocates along fixed guide *a*. Endless flexible link *4* runs over pulleys *1*, *2* and *3*. When pulley *1* rotates, pulleys *2* and *3* rotate about their axes and slide *5* with pulleys *3* can travel with any kind of motion along guide *a*.

3570	FLEXIBLE-LINK DIFFERENTIAL MECHANISM WITH A MOVABLE PULLEY	CFL DF



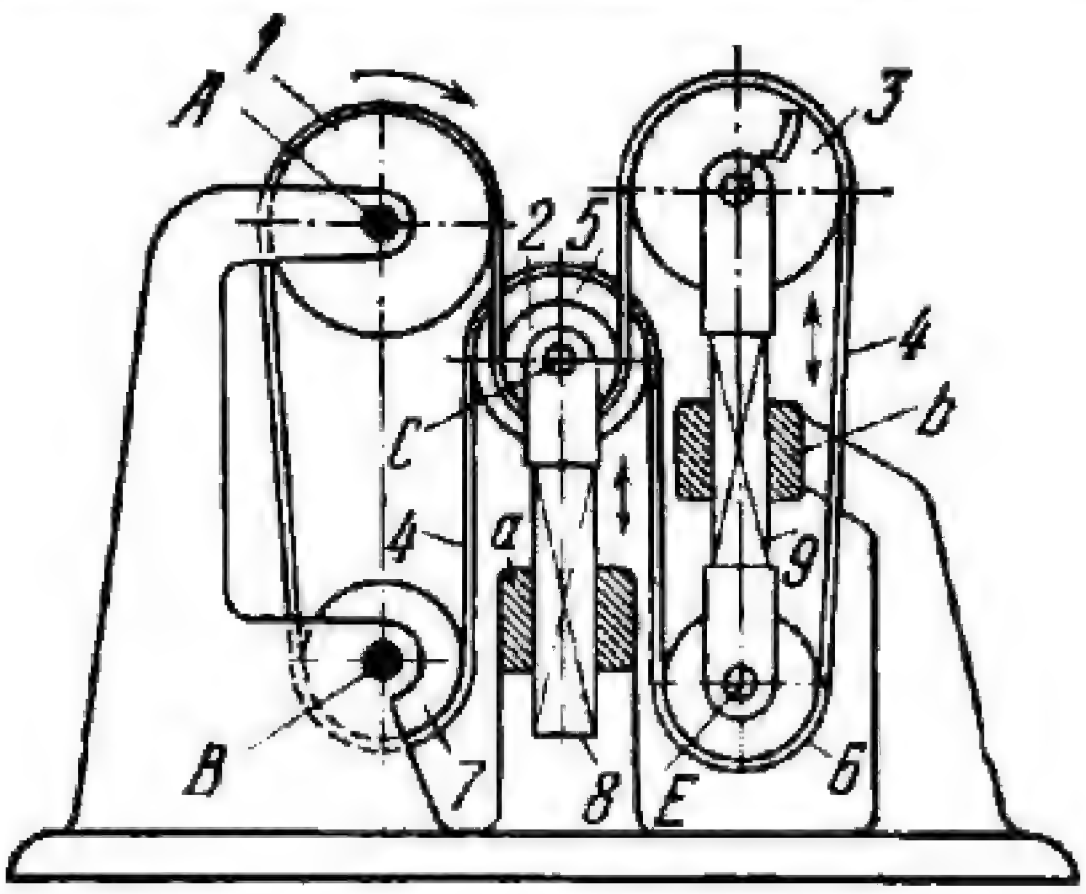
Pulley *1* rotates about fixed axis *A*. Identical pulleys *3* rotate about fixed axes *B*. Crosspiece *5* reciprocates along fixed guides *a* and *b*, and carries pulley *4* which rotates about axis *C*. Endless flexible link *2* runs over pulleys *1*, *3* and *4*. When pulley *1* rotates, pulleys *3* and *4* rotate about their axes and crosspiece *5* with pulley *4* can travel with any kind of motion along guides *a* and *b*.

3571	**FLEXIBLE-LINK DIFFERENTIAL MECHANISM OF A RHOMBUS LINKAGE**	CFL DF



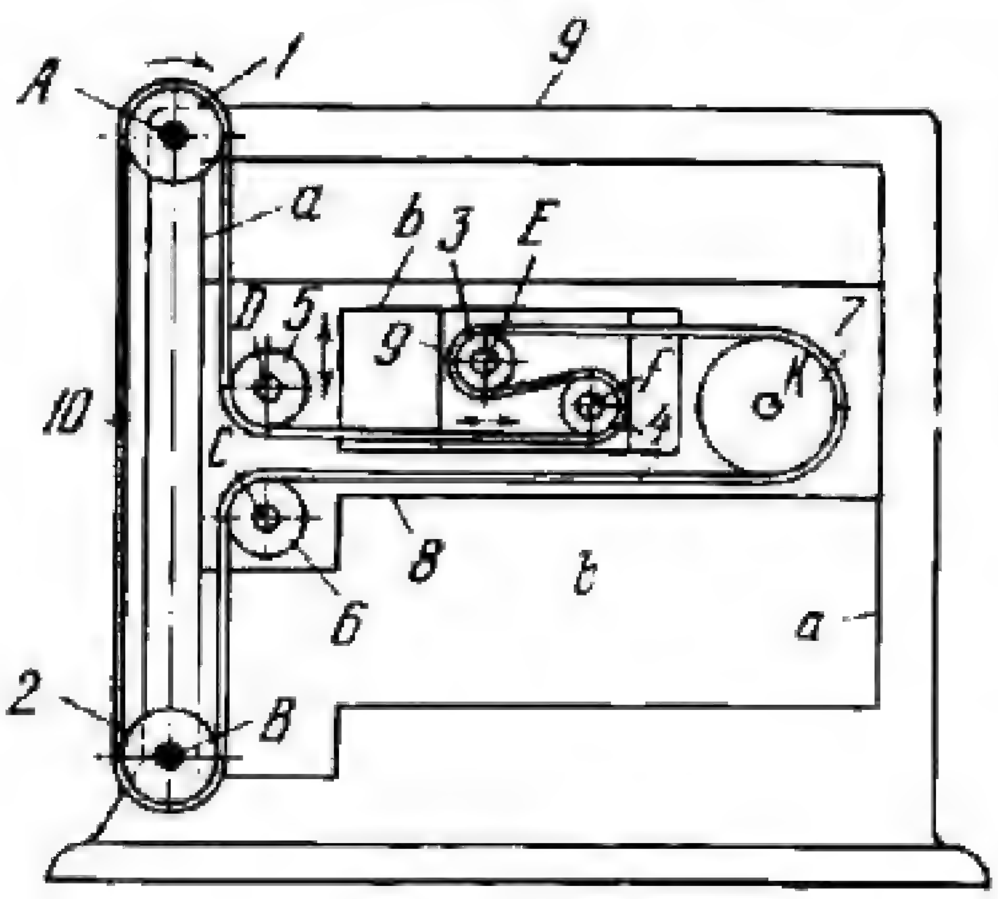
Four identical pulleys *1*, *2*, *3* and *4* rotate about axes *A*, *B*, *C* and *D*, and are connected by turning pairs to links *5*, *6*, *7* and *8* whose lengths comply with the condition: $\overline{AC} = \overline{CB} = \overline{BD} = \overline{DA}$, i.e. figure *ACBD* is a rhombus linkage. Two identical pulleys *9* and *10* rotate about axes *E* and *F* of link *7* and of link *11* which carries weight *12* and can turn freely about axis *K* of link *6*. Endless flexible link *13* runs over pulleys *1*, *2*, *3*, *4*, *9* and *10*. When pulley *2* rotates about fixed axis *B*, all the other pulleys rotate about their axes, and axis *A* of pulley *1* can travel with any kind of motion along axis *y*. By means of weight *12*, pulley *10* maintains the required tension of link *13*.

3572	**FLEXIBLE-LINK DIFFERENTIAL MECHANISM WITH FOUR MOVABLE PULLEYS**	CFL DF



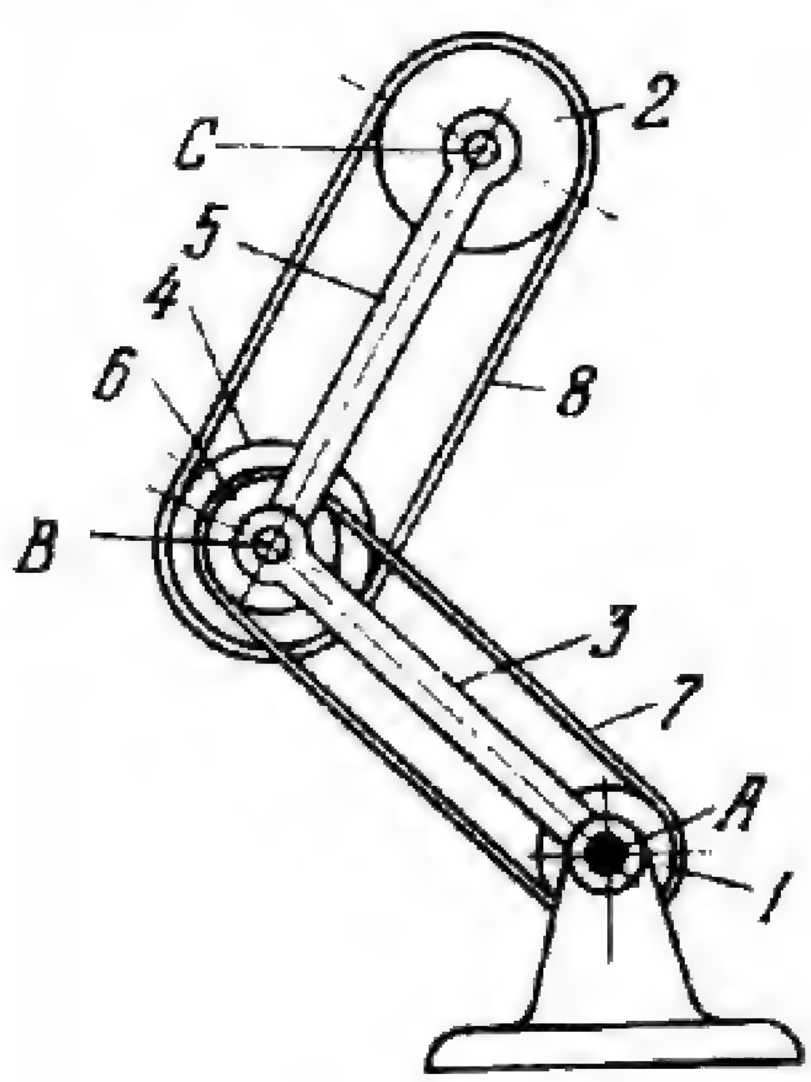
Pulleys *1* and *7* rotate about fixed axes *A* and *B*. Pulleys *2* and *5* rotate about axis *C* of slide *8* which reciprocates in fixed guide *a*. Pulleys *3* and *6* rotate about axes *D* and *E* of slider *9* which reciprocates in fixed guide *b*. Endless flexible link *4* runs over pulleys *1*, *2*, *3*, *5*, *6* and *7*. When pulley *1* rotates about axis *A*, all the other pulleys rotate about their axes, and slides *8* and *9* can travel in guides *a* and *b* with any kind of motion.

3573	FLEXIBLE-LINK DIFFERENTIAL MECHANISM WITH FIVE MOVABLE PULLEYS	CFL DF



Identical pulleys *1* and *2* rotate about fixed axes *A* and *B*. Identical pulleys *5* and *6* rotate about axes *D* and *C* of slide *8* which reciprocates in fixed guides *a-a*. Also mounted on slide *8* is axis *K* about which pulley *7* rotates. Identical pulleys *3* and *4* rotate about axes *E* and *F* of cross-slide *9* which reciprocates in guides *b-b* of slide *8*. Endless flexible link *10* runs over all seven pulleys. When pulley *1* rotates about axis *A*, all the other pulleys rotate about their axes and slide *8* and cross-slide *9* can travel in guides *a-a* and *b-b* with any kind of motion.

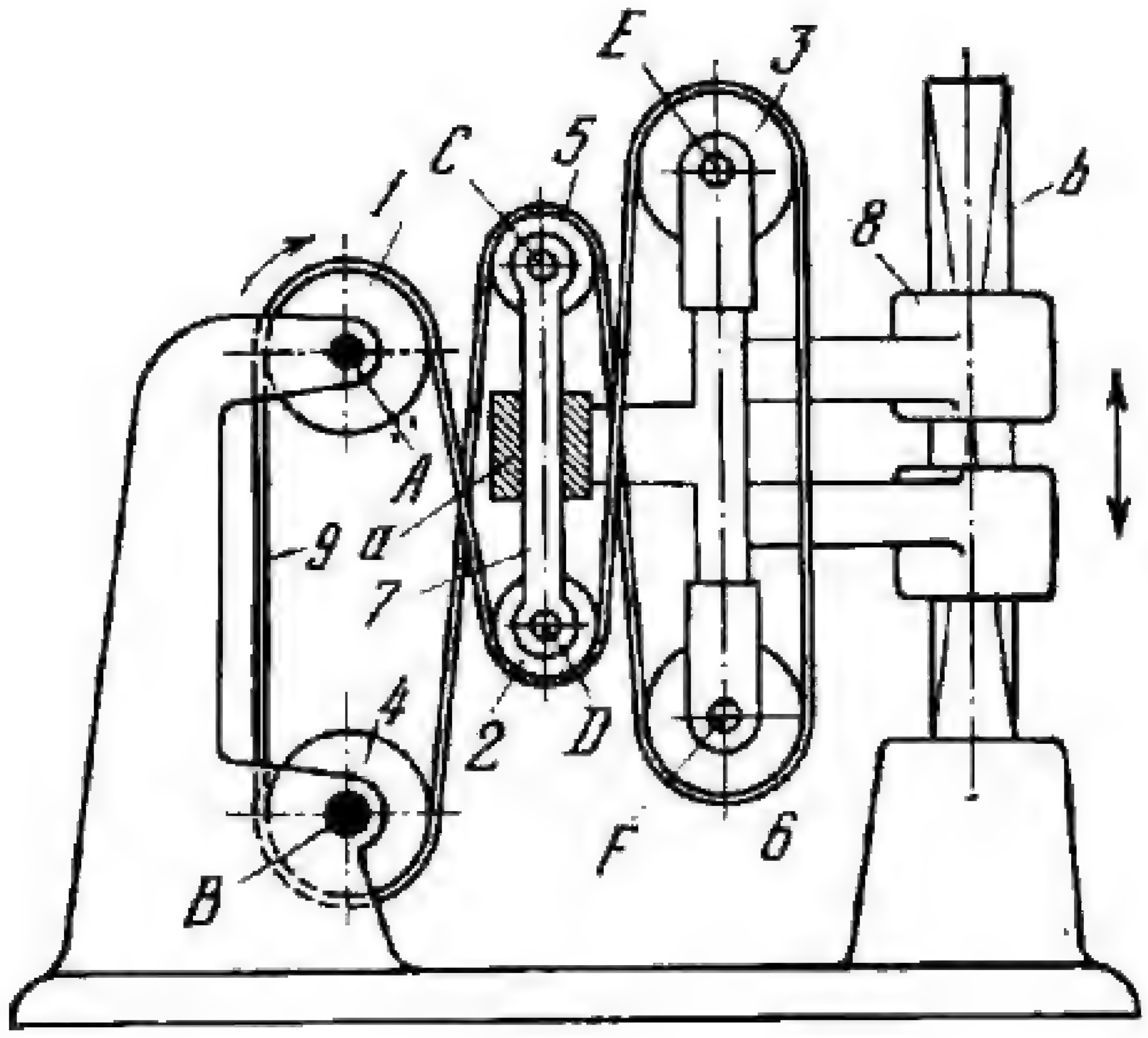
3574	FLEXIBLE-LINK DIFFERENTIAL MECHANISM OF A DOUBLE PENDULUM	CFL DF



The double pendulum consists of link *3*, turning about fixed axis *A*, and link *5* which is connected by turning pair *B* to link *3*. Two identical pulleys *1* and *6* rotate about axes *A* and *B*. Two identical pulleys *2* and *4* rotate about axes *C* and *B*. Pulleys *6* and *4* are rigidly attached together. Two endless flexible links *7* and *8* run over pulleys *1* and *6*, and *4* and *2*. When pulley *1* rotates about axis *A*, all the other pulleys rotate, and axis *C* can be moved to any point in the plane of the drawing within a radius of

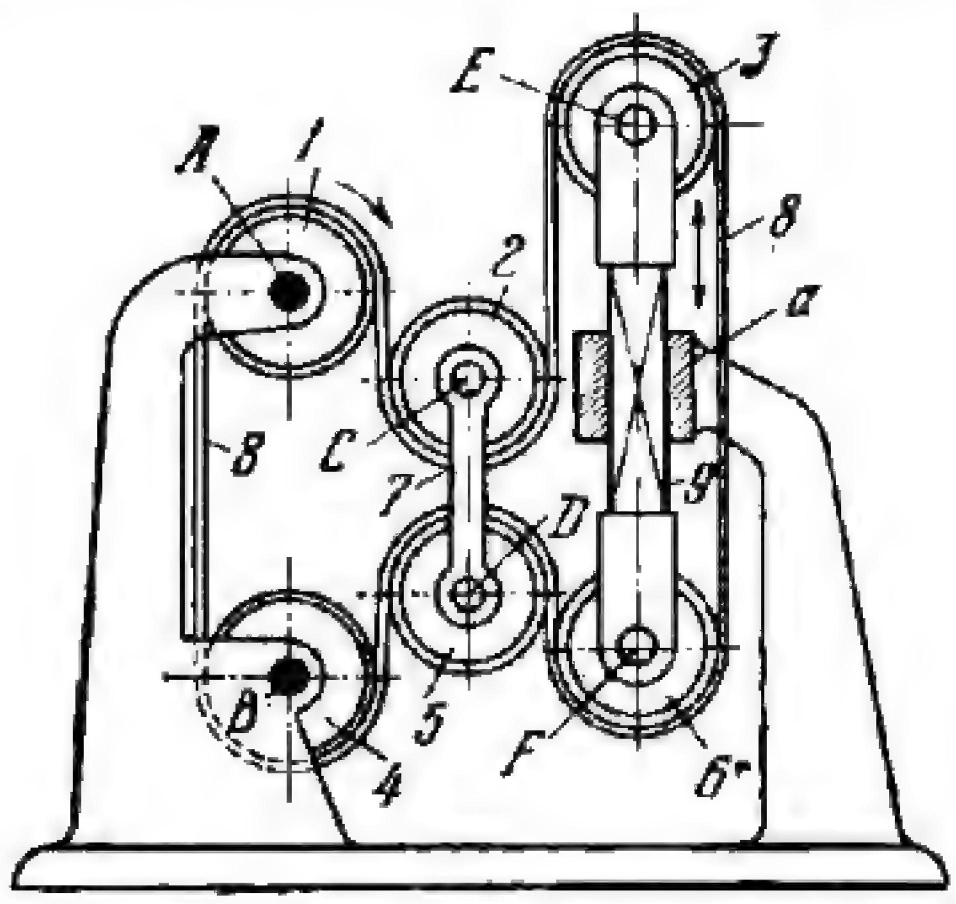
$$R = \overline{AB} + \overline{BC}.$$

3575	FLEXIBLE-LINK DIFFERENTIAL MECHANISM WITH FOUR MOVABLE PULLEYS	CFL DF



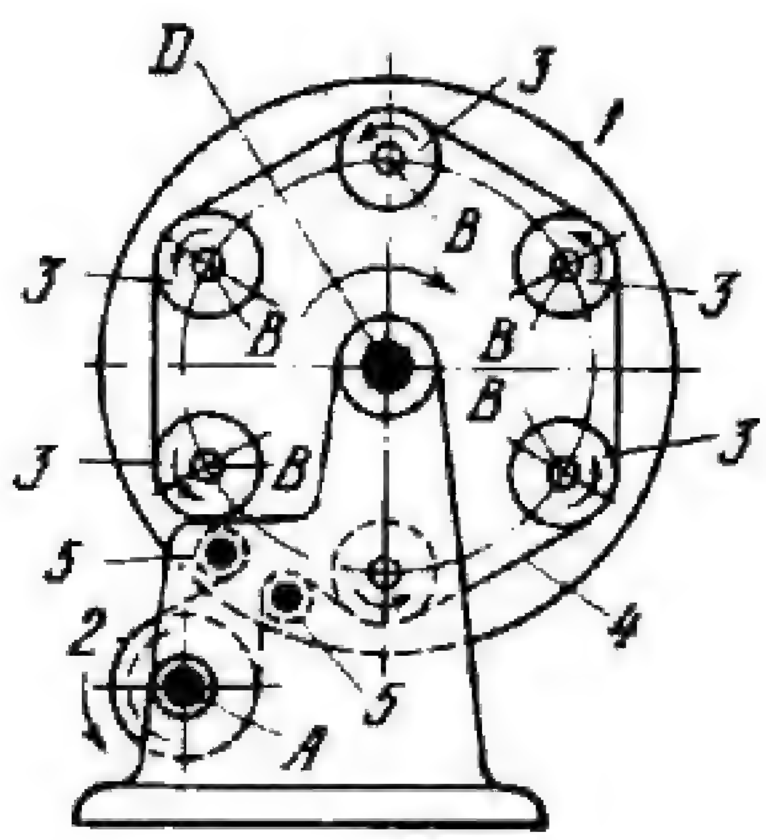
Identical pulleys *1* and *4* rotate about fixed axes *A* and *B*. Identical pulleys *2* and *5* rotate about axes *D* and *C* of slide *7* which reciprocates in guide *a* of slide *8*. Identical pulleys *3* and *6* rotate about axes *E* and *F* of slide *8* which reciprocates along fixed guide *b*. Endless flexible link *9* runs over all six pulleys. When pulley *1* rotates about axis *A*, all the other pulleys rotate about their axes and slides *7* and *8* can travel in and along guides *a* and *b* with any kind of motion.

3576	FLEXIBLE-LINK DIFFERENTIAL MECHANISM WITH TWO SUSPENDED PULLEYS	CFL DF



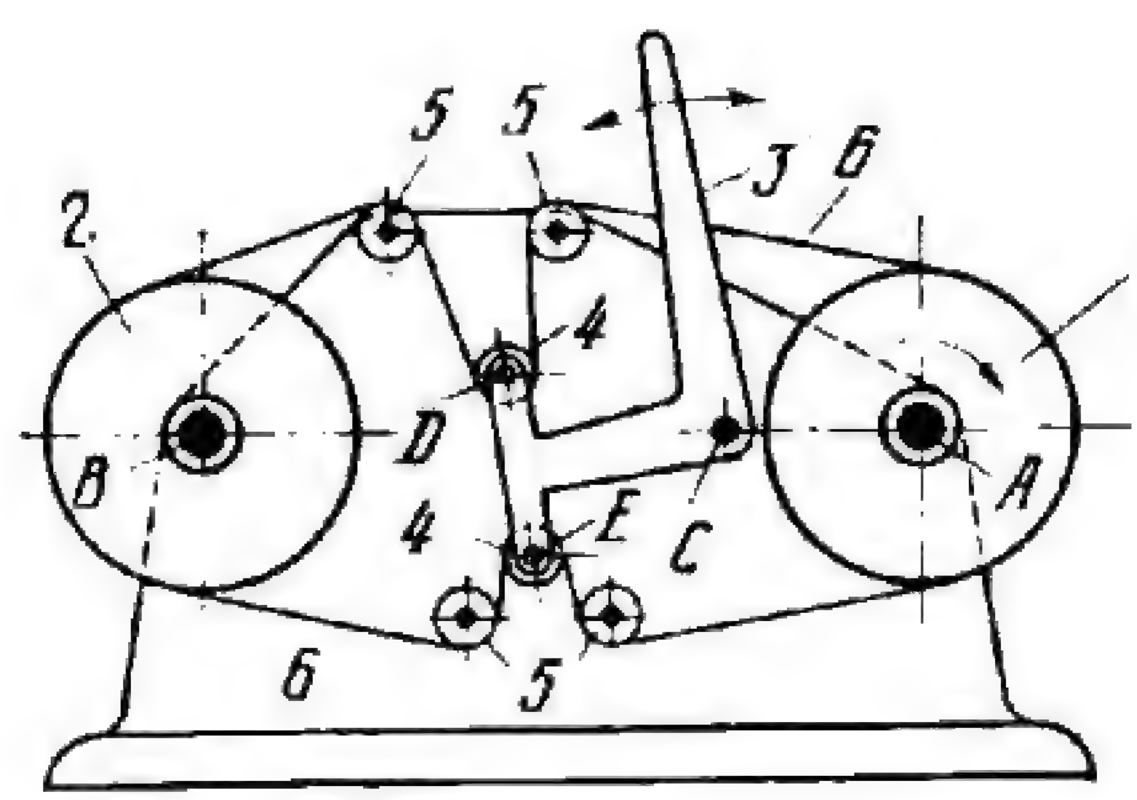
Identical pulleys *1* and *4* rotate about fixed axes *A* and *B*. Identical pulleys *3* and *6* rotate about axes *E* and *F* of slide *9* which reciprocates in fixed guide *a*. Identical pulleys *2* and *5* rotate about axes *C* and *D* of link *7*. Link *7* with pulleys *2* and *5* is freely suspended on endless flexible link *8* which runs over all six pulleys. When pulley *1* rotates about axis *A*, all the other pulleys rotate about their axes, and slide *9* can travel in guide *a* with any kind of motion.

3577	FLEXIBLE-LINK DIFFERENTIAL MECHANISM WITH A SIX-PULLEY DISK	CFL DF



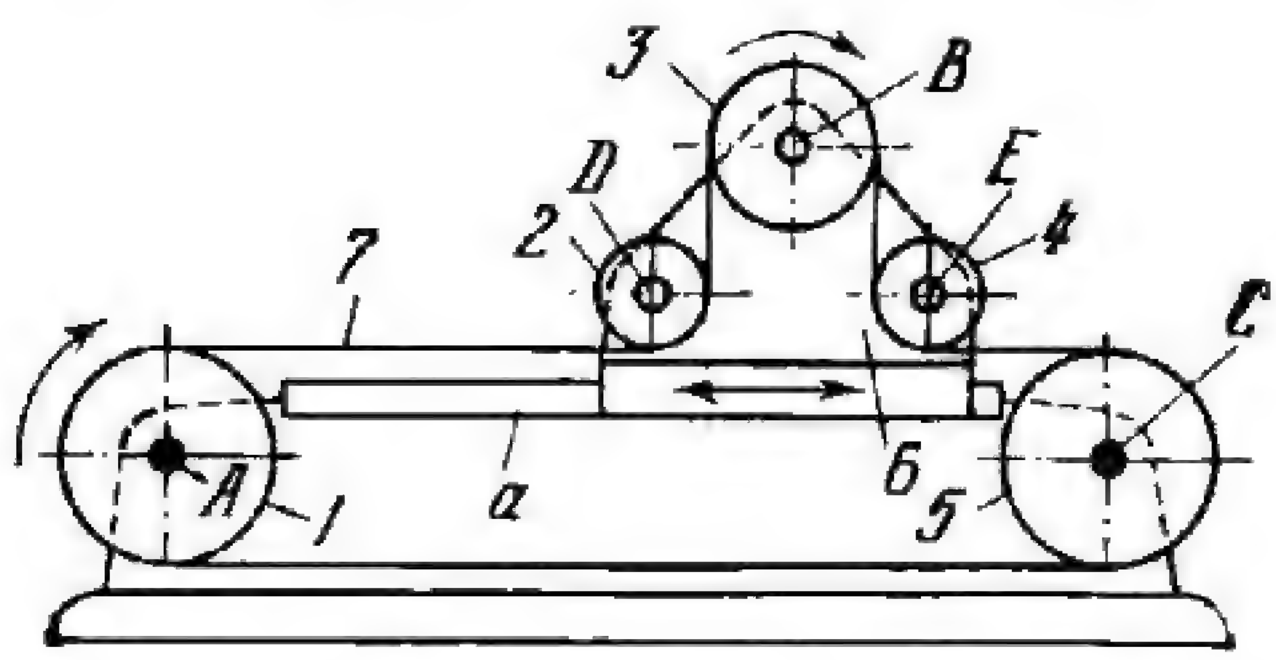
Pulley *2* rotates about fixed axis *A*. Six identical pulleys *3* rotate about axes *B* of disk *1* which rotates about fixed axis *D*. Endless flexible link *4* runs over pulley *2*, two guide rollers *5*, rotating about fixed axes, and six pulleys *3*. The resultant motion of pulleys *3* is the sum of their independent rotation due to the rotation of pulley *2* and of disk *1*.

3578	FLEXIBLE-LINK DIFFERENTIAL MECHANISM WITH OSCILLATING PULLEYS	CFL DF



Identical pulleys *1* and *2* rotate about fixed axes *A* and *B*. Endless flexible link *6* runs over pulleys *1* and *2*, four guide rollers *5*, rotating about fixed axes, and two identical pulleys *4* which rotate about axes *D* and *E* of lever *3*. Lever *3* turns about fixed axis *C*. When pulley *1* rotates about axis *A*, all the other pulleys and rollers rotate about their axes, and lever *3* can be turned to various positions.

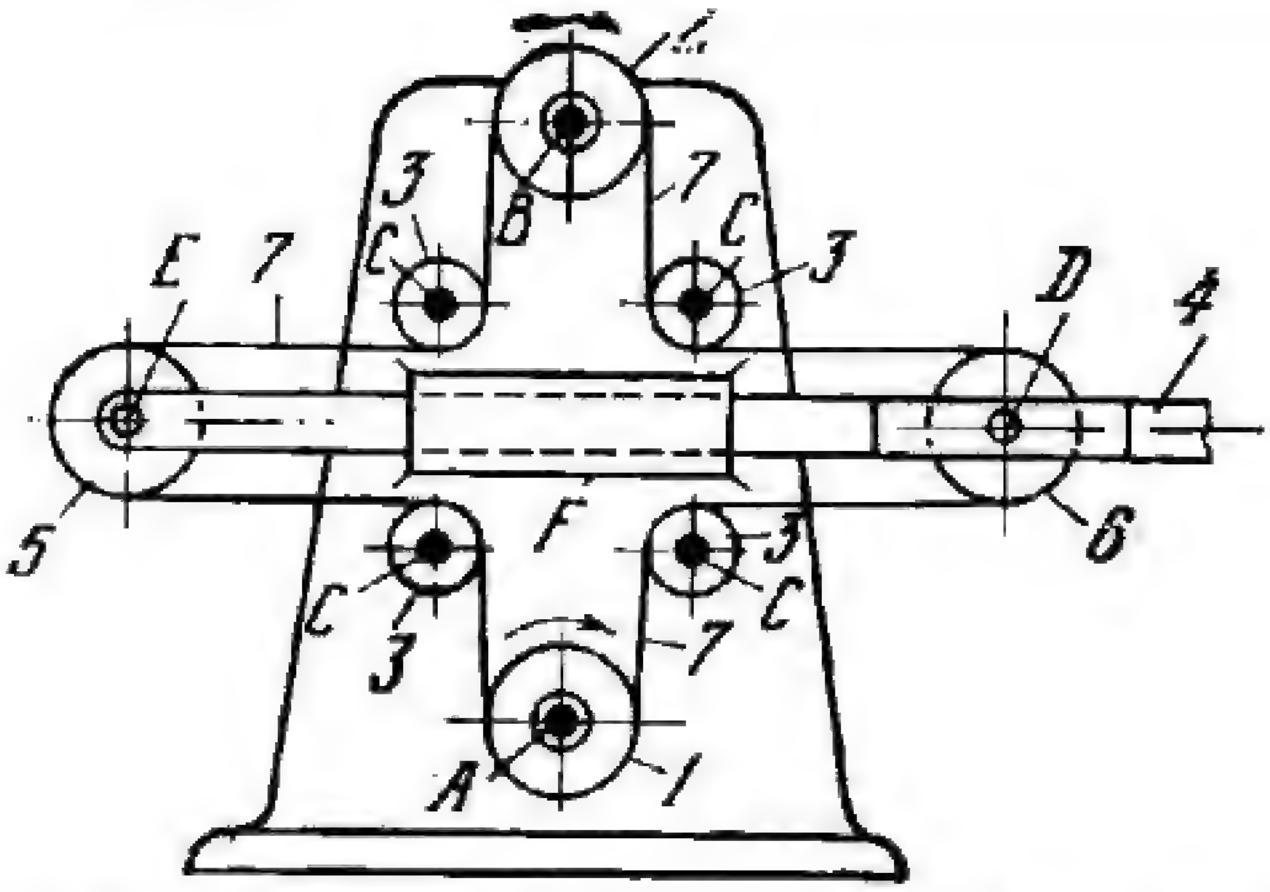
3579	FLEXIBLE-LINK DIFFERENTIAL MECHANISM WITH A MOVABLE BEARING	CFL DF



Identical pulleys *1* and *5* rotate about fixed axes *A* and *C*. Driven pulley *3* rotates about axis *B* of movable bearing housing *6*. Identical guide pulleys *2* and *4* rotate about axes *D* and *E* of bearing housing *6*. Endless flexible link *7* runs over pulleys *1*, *2*, *3*, *4* and *5*. When pulley *1* rotates about axis *A*, all the other pulleys rotate about their axes, and bearing housing *6* can be moved to any position along fixed guide *a*.

3580 FLEXIBLE-LINK DIFFERENTIAL MECHANISM WITH TWO MOVABLE PULLEYS

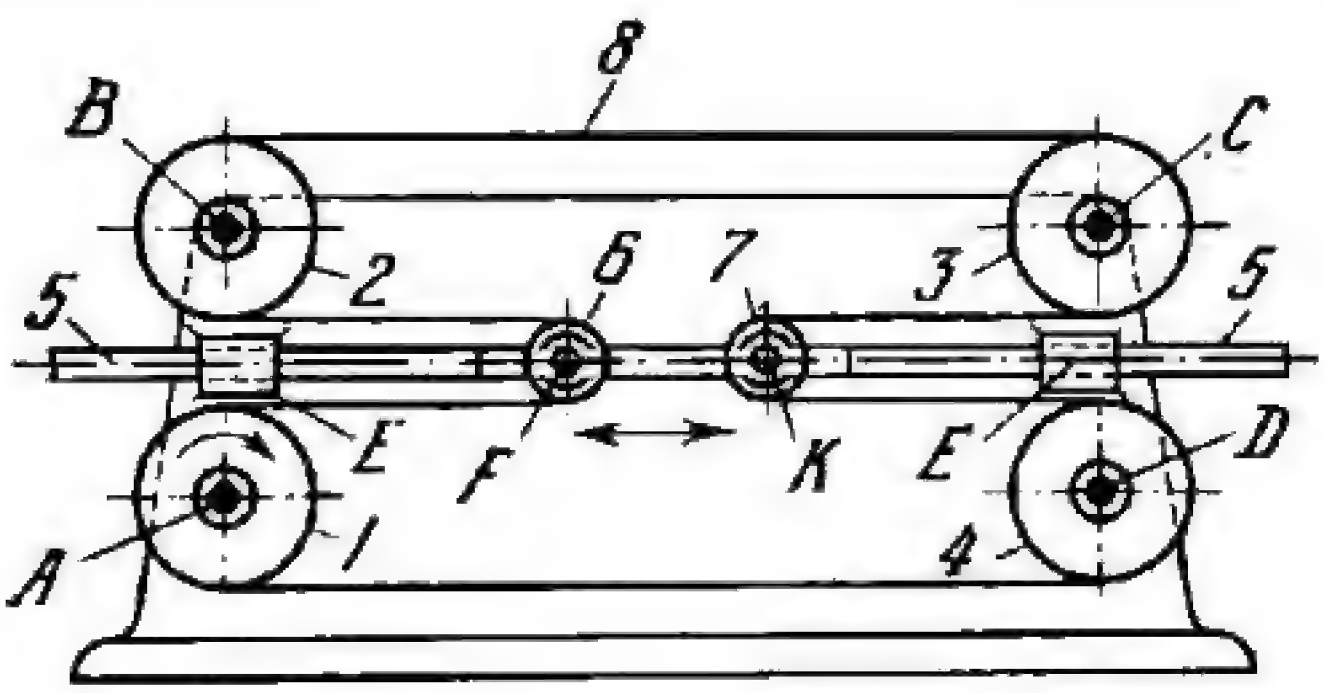
CFL DF



Pulleys *1* and *2* rotate about fixed axes *A* and *B*. Guide pulleys *3* rotate about fixed axes *C*. Identical pulleys *5* and *6* rotate about axes *E* and *D* of slide *4* which reciprocates in fixed guide *F*. Endless flexible link *7* runs over all eight pulleys. When pulley *1* rotates about axis *A*, all the other pulleys rotate about their axes, and slide *4* can travel in guide *F* with any kind of motion.

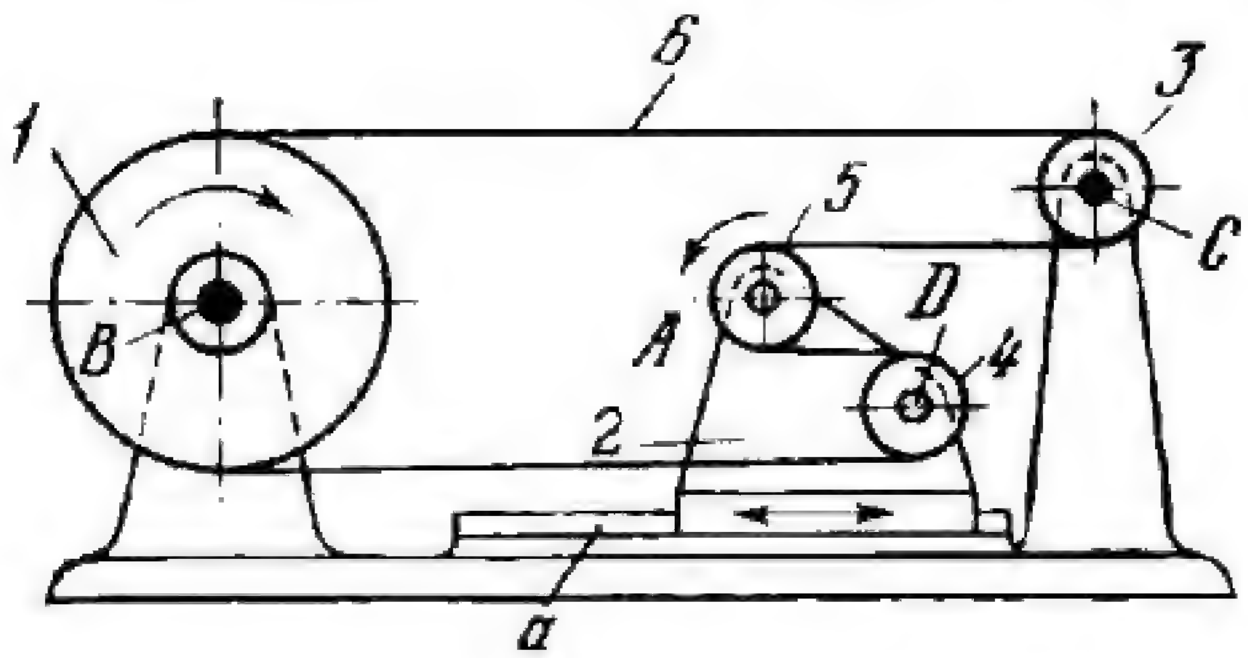
3581 FLEXIBLE-LINK DIFFERENTIAL MECHANISM WITH TWO MOVABLE PULLEYS

CFL DF



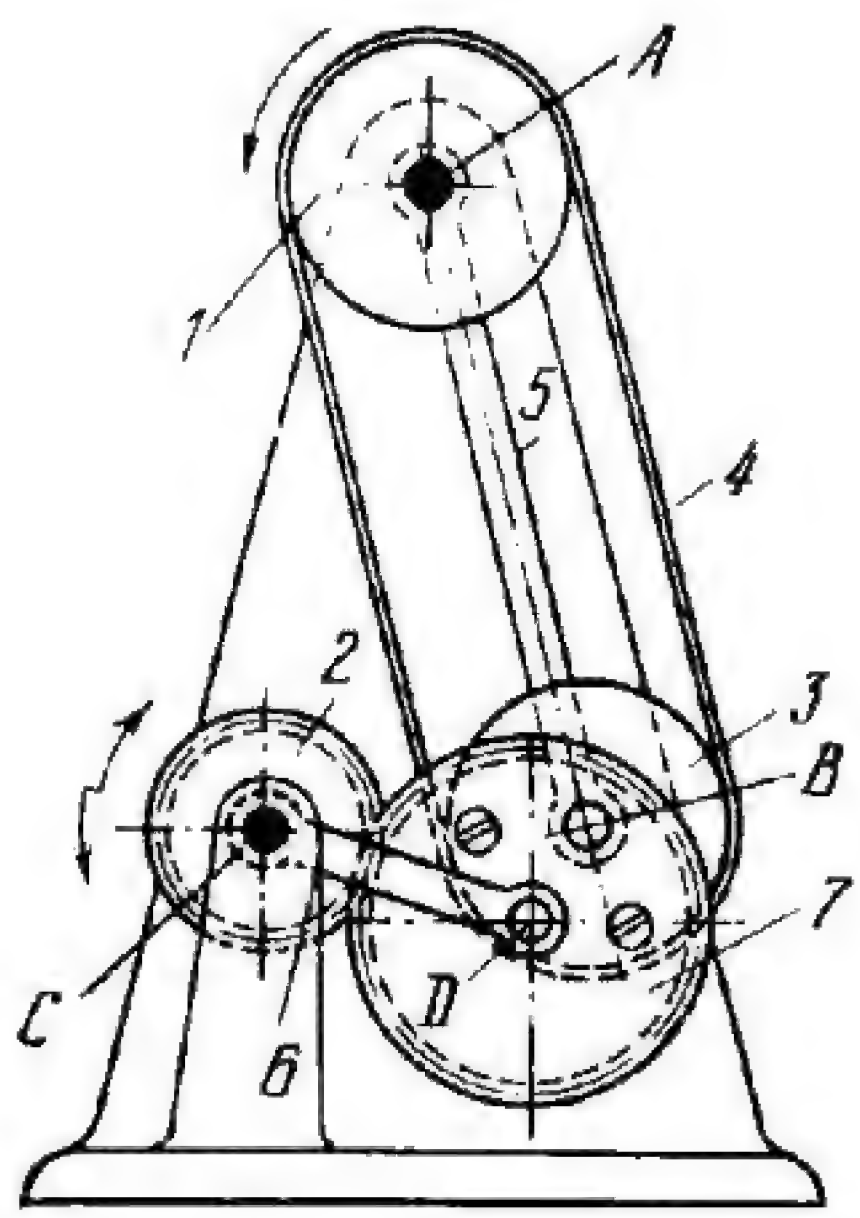
Four identical pulleys *1*, *2*, *3* and *4* rotate about fixed axes *A*, *B*, *C* and *D*. Identical pulleys *6* and *7* rotate about axes *F* and *K* of slide *5* which moves in fixed guides *E*. Endless flexible link *8* runs over all six pulleys. When pulley *1* rotates about axis *A*, all the other pulleys rotate about their axes, and slide *5* can travel in guides *E* with any kind of motion.

3582	FLEXIBLE-LINK DIFFERENTIAL MECHANISM WITH A MOVABLE BEARING	CFL DF



Pulleys *1* and *3* rotate about fixed axes *B* and *C*. Driven pulley *5* rotates about axis *A* of movable bearing housing *2*. Pulley *4* rotates about axis *D* of housing *2*. Endless flexible link *6* runs over all four pulleys. When pulley *1* rotates about axis *B*, all the other pulleys rotate about their axes, and bearing housing *2* can be moved to any position along fixed guide *a*.

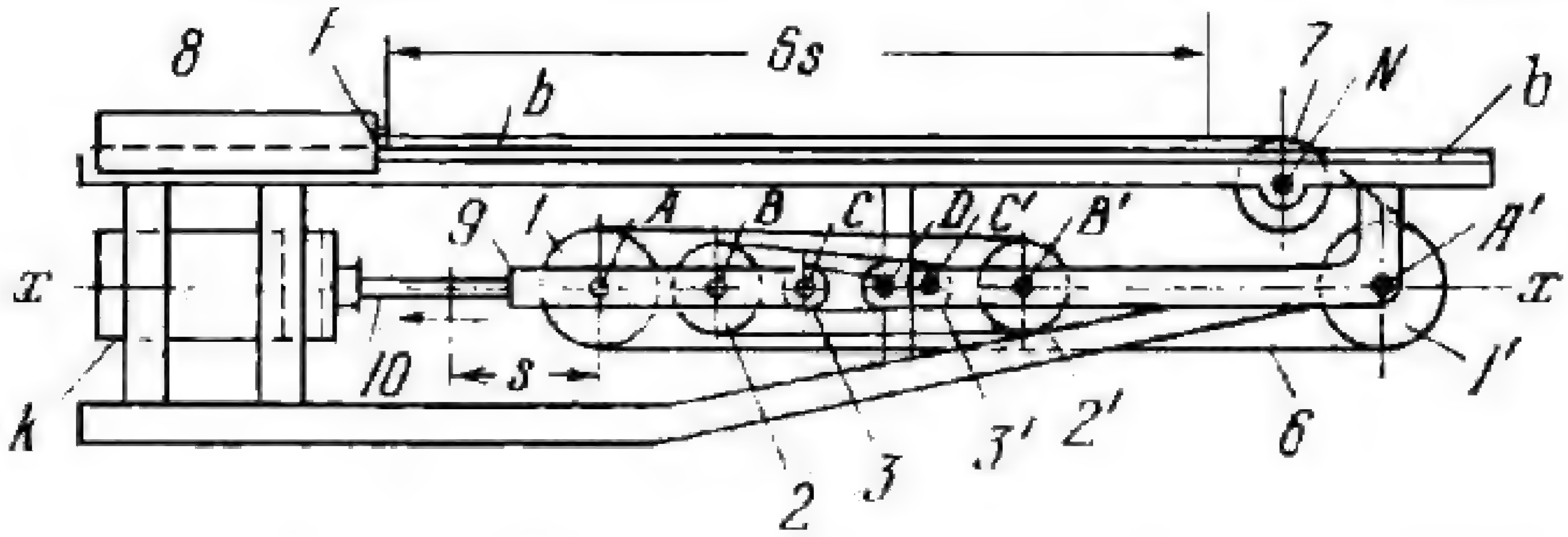
3583	FLEXIBLE-LINK PLANETARY GEARING MECHANISM	CFL DF



Pulley *1* rotates about fixed axis *A*. Link *5* turns about axis *A* and is connected by turning pair *B* to pulley *3*, identical to pulley *1*. Endless flexible link *4* runs over pulleys *1* and *3*. Rigidly attached to pulley *3* is planet gear *7* which meshes with sun gear *2*. Gear *2* rotates about fixed axis *C*. Carrier *6* rotates about axis *C* and is connected by turning pair *D* to gear *7*. When pulley *1* rotates at uniform speed, gear *2* can rotate at nonuniform speed and in either direction.

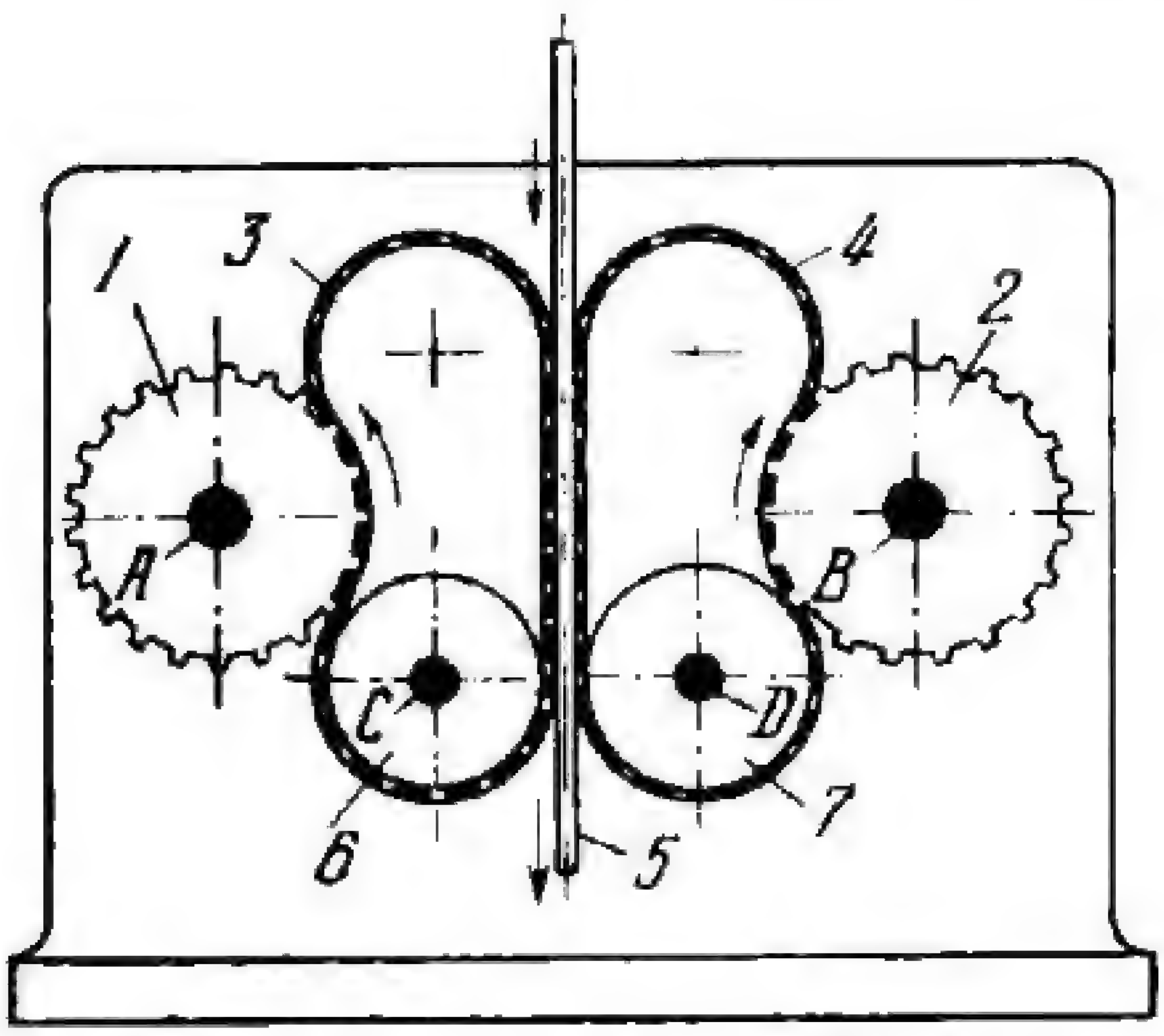
8. MECHANISMS OF OTHER FUNCTIONAL DEVICES (3584 through 3590)

3584	FLEXIBLE-LINK BLOCK-AND-TACKLE MECHANISM OF A CATAPULT	CFL FD



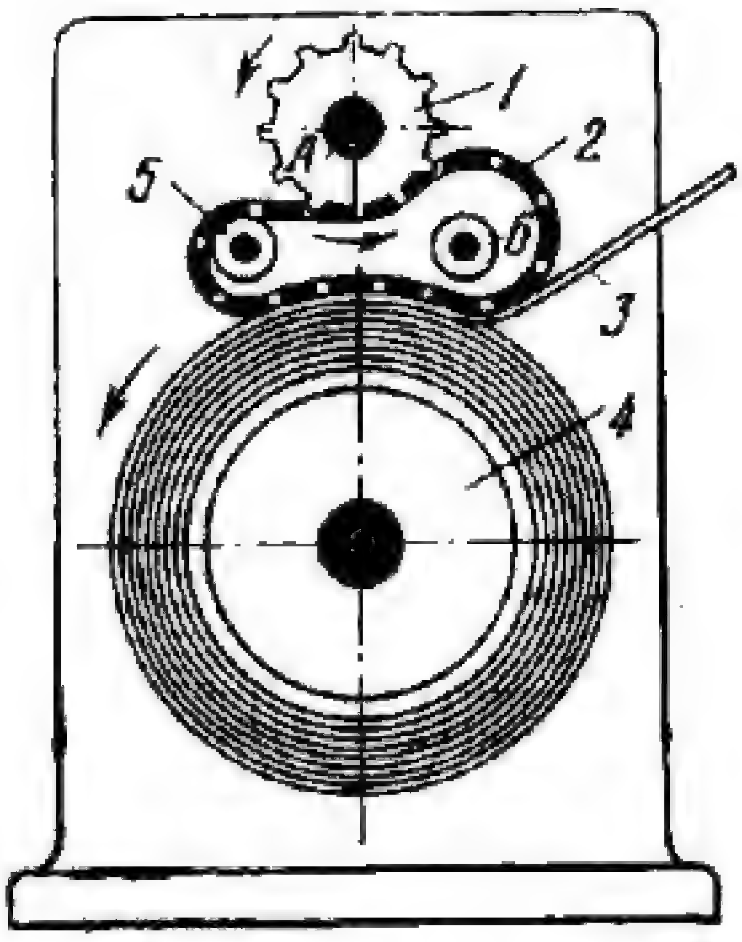
Piston rod *10* of pneumatic cylinder *k* has stroke *s*. Displaced together with rod *10* is pulley block *9* in which three pulleys, *1*, *2* and *3*, are mounted. Pulleys *1*, *2* and *3* rotate about axes *A*, *B* and *C* of block *9*. Pulleys *1'*, *2'* and *3'*, of the same size as *1*, *2* and *3*, rotate about fixed axes *A'*, *B'* and *C'*. Flexible link *6* has one end attached to the base at point *D*, and runs consecutively over pulleys *3*, *3'*, *2*, *2'*, *1* and *1'*, and over pulley *7* which rotates about fixed axis *N*. The other end of link *6* is attached at point *F* to platform *8* of the catapult which travels along fixed guides *b*-*b*. When piston rod *10* travels a distance to the left equal to *s*, platform *8* travels a distance to the right equal to $S = 6\ s$.

3585	FLEXIBLE-LINK MECHANISM FOR ADVANCING MOTION PICTURE FILM	CFL FD



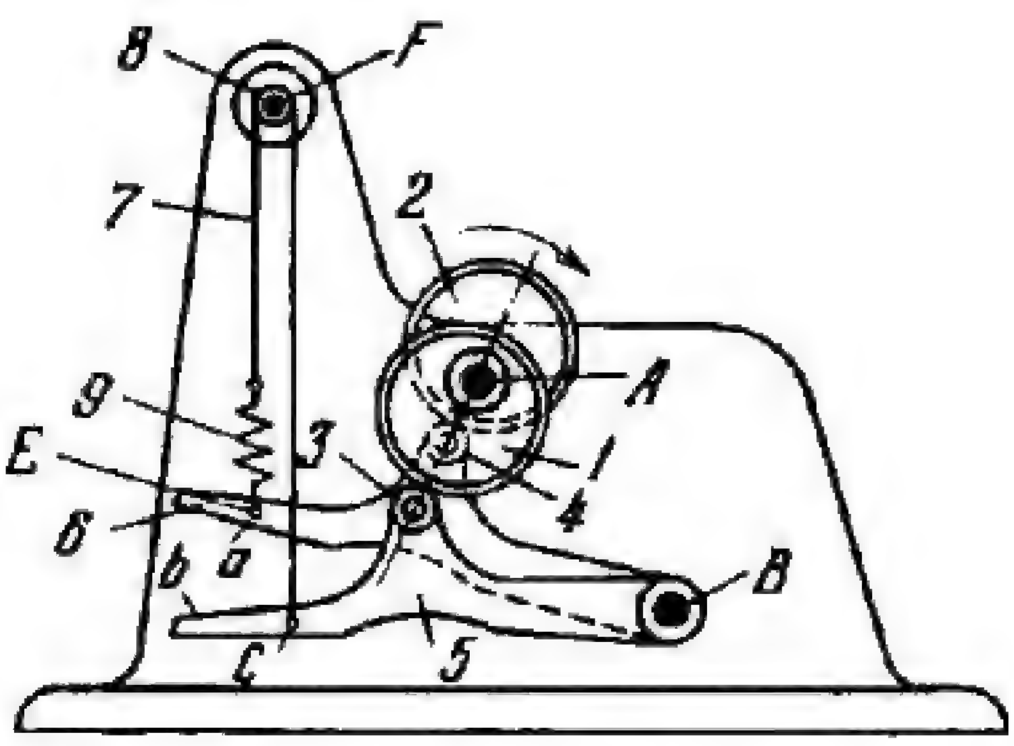
Sprocket wheels *1* and *2* rotate about fixed axes *A* and *B* and their teeth engage the slots in endless steel belts *3* and *4* which run over pulleys *6* and *7*, rotating about fixed axes *C* and *D*. When sprocket wheels *1* and *2* rotate, the first counterclockwise and the second clockwise, film *5* is gripped by the inner sides of links *3* and *4* and, owing to friction, advanced downward.

3586	FLEXIBLE-LINK MECHANISM FOR ADVANCING MOTION PICTURE FILM	CFL FD



Sprocket wheel *1* rotates about fixed axis *A* and its teeth engage the slots in endless steel belt *2* which is in contact with either guide roller *5* or *6*. When sprocket wheel *1* rotates counterclockwise, band *2* advances film *3*, owing to friction, winding it onto drum *4*. The provision of two guide rollers, *5* and *6*, enables the film to be advanced in either direction by friction, winding it on or off of drum *4*, by reversing wheel *1*.

3587	FLEXIBLE-LINK SHEAR MECHANISM	CFL FD



Two identical rigidly attached round eccentrics, *1* and *2*, rotate about fixed axis *A*. Levers *5* and *6* have shear blades *b* and *a*, turn about fixed axis *B* and carry rollers *3* and *4* which roll along the contours of eccentrics *1* and *2*. Flexible link *7* has one end attached at point *C* to lever *5*, runs over pulley *8*, rotating about fixed axis *F*, and has its other end attached through spring *9* at point *E* to lever *6*. When eccentrics *1* and *2* rotate, blades *a* and *b* have a shearing motion.

3588	FLEXIBLE-LINK SLAY MECHANISM	CFL FD

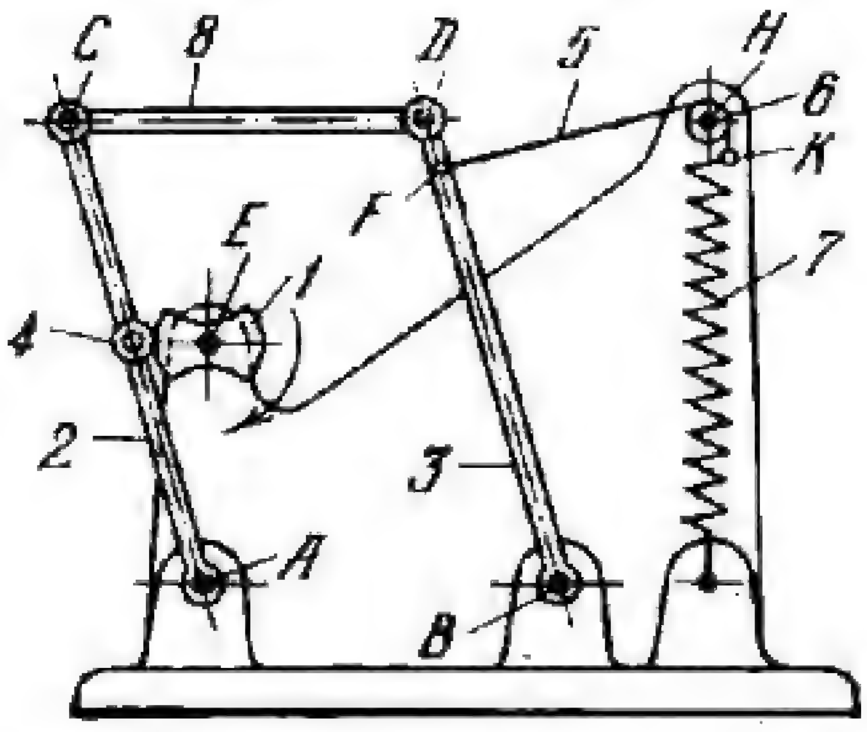
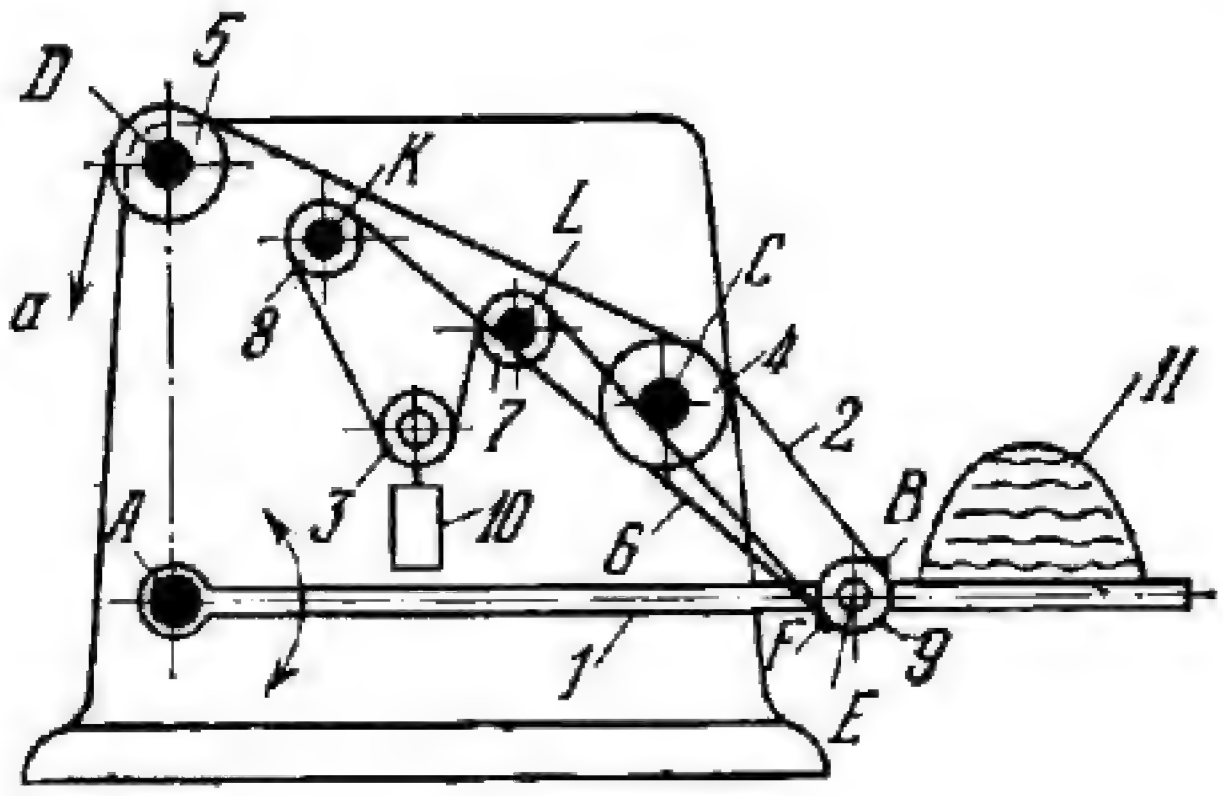


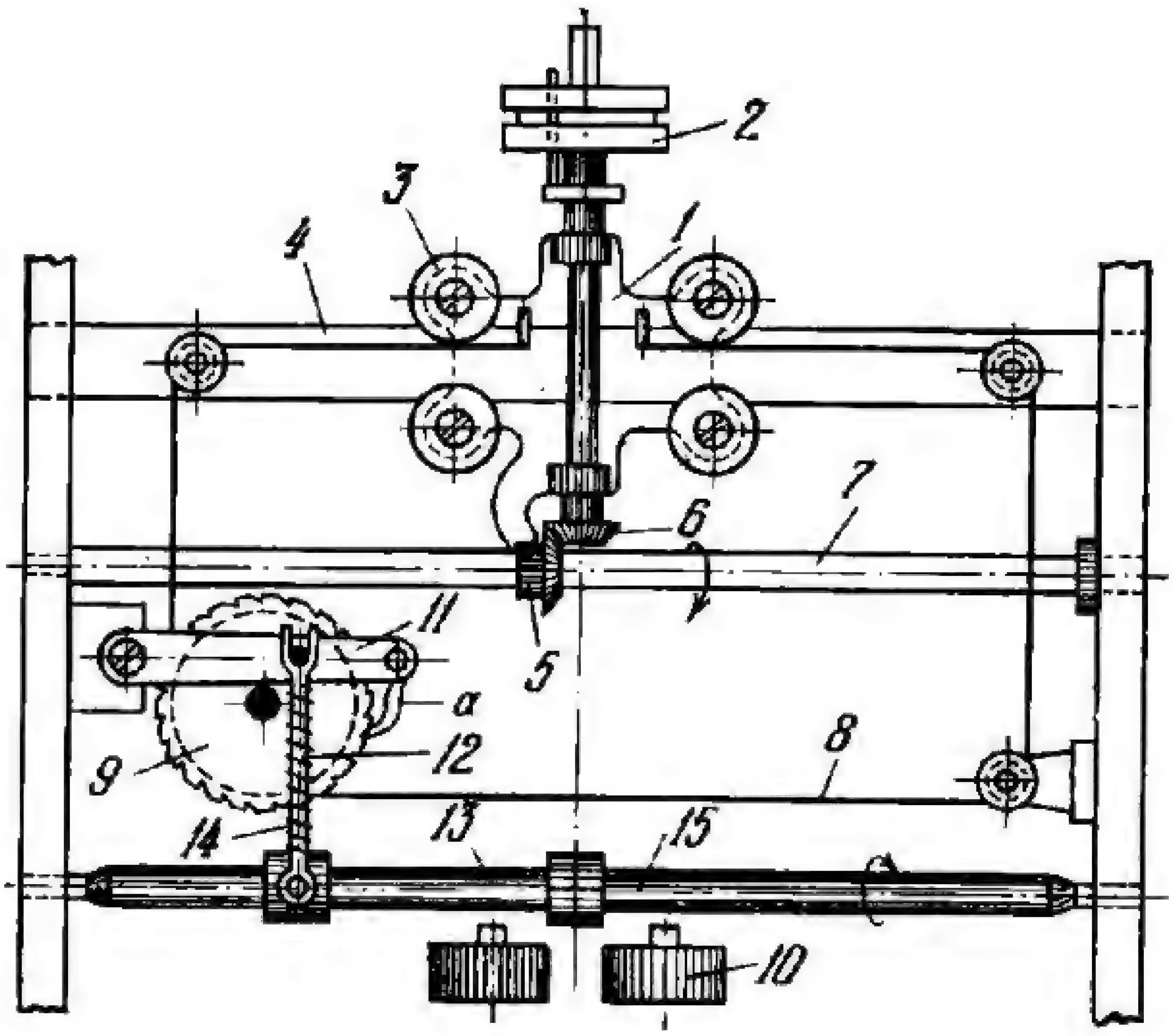
Plate cam *1* rotates about fixed axis *E*. Slay *2* turns about fixed axis *A* and carries roller *4* which rolls along the contour of cam *1*. Link *8* is connected by turning pairs *C* and *D* to slay *2* and to link *3* which turns about fixed axis *B*. Pulley *6* rotates about fixed axis *H*. Flexible link *5* has one end attached at point *F* to link *3*, runs over pulley *6*, and has its other end attached at point *K* to spring *7* which holds roller *4* in contact with cam *1*. When cam *1* rotates, slay *2* oscillates.

3589	FLEXIBLE-LINK MECHANISM OF A HAY STACKER	CFL FD



Lever *1* of the stacker turns about fixed axis *A*. Flexible link *2* is attached at point *B* to drum *9* which rotates about axis *E* of lever *1*. Link *2* runs over pulleys *4* and *5* which rotate about fixed axes *C* and *D*. Flexible link *6* is attached at point *F* to drum *9* and runs over pulleys *7* and *8*, rotating about fixed axes *L* and *K*, and freely suspended pulley *3* carrying weight *10*. To raise pile *11*, end *a* of link *2* is pulled in the direction shown by the arrow. Weight *10* counterbalances the weight of lever *1*.

3590	FLEXIBLE-LINK MECHANISM OF A PRINTING DEVICE	CFL FD



Carriage *1* of type wheel *2* has four grooved sheaves *3* which ride along rule *4*. Motion is transmitted to type wheel *2* by meshing bevel gears *5* and *6*. Gear *5* can slide along shaft *7*. Carriage travel is controlled by cable *8* which runs over a drum rigidly attached to and located behind paper strip feeding ratchet wheel *9*. Printing electromagnet *10*, performing the printing action, raises horizontal lever *11* when armature *15* of the electromagnet moves downward. Lever *11* is raised by means of fork *12* mounted on rotating shaft *13*. When electromagnet *10* is demagnetized, coil spring *14* pulls lever *11* downward so that pawl *a* turns wheel *9* through an angle corresponding to one tooth. This advances carriage *1* a distance equal to one letter.

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